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INTRA-SPACE MONITORING DEVICE

Publication number: JP2004097302 (A)
Publication date: 2004-04-02
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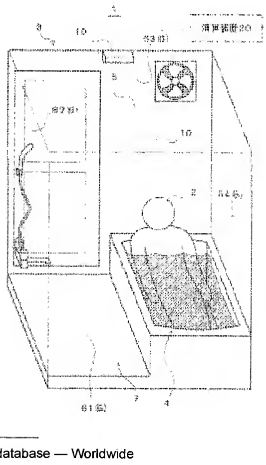
Classification:
- international: *G03B15/00; A61B5/00; A61B5/11; G08B21/04;* **G03B15/00; A61B5/00; A61B5/11; G08B21/00;** (IPC1-7): A61B5/11; A61B5/00; G03B15/00; G08B21/04
- European:
Application number: JP20020260476 20020905
Priority number(s): JP20020260476 20020905

Also published as:
JP3979238 (B2)

Abstract of **JP 2004097302 (A)**

PROBLEM TO BE SOLVED: To provide an intra-space monitoring device which not only correctly deciding the dangerous state of an object but also is simple.



(19)日本国特許庁(JP)　(12)特　許　公　報(B2)　(11)特許番号
特許第3979238号
(P3979238)
(45)発行日　平成19年9月19日(2007.9.19)　(24)登録日　平成19年7月6日(2007.7.6)

(51) Int.Cl.		F I		
A61B 5/11	(2006.01)	A61B	5/10	310A
A61B 5/00	(2006.01)	A61B	5/00	102A
G03B 15/00	(2006.01)	G03B	15/00	S
G08B 21/04	(2006.01)	G03B	15/00	U
		G08B	21/04	

請求項の数 6　(全 26 頁)

(21)出願番号　特願2002-260476 (P2002-260476)
(22)出願日　平成14年9月5日(2002.9.5)
(65)公開番号　特開2004-97302 (P2004-97302A)
(43)公開日　平成16年4月2日(2004.4.2)
審査請求日　平成17年2月8日(2005.2.8)

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(54)【発明の名称】空間内監視装置

(57)【特許請求の範囲】

【請求項１】

対象領域内の３次元情報を取得する１つの３次元センサと；

前記取得した３次元情報に基づいて、前記対象領域内の高さの変化を検出する高さ変化検出手段と；

前記検出された高さの変化に基づいて、呼吸、体動及び移動をする対象物の位置を検出する位置検出手段と；

前記検出された高さの変化に基づいて、前記対象物の呼吸、体動及び移動の動きを検出する動き検出手段と；

前記検出された対象物の位置と動きに基づいて、前記対象物が危険な状態にあるか否かを判定する危険判定手段とを備え；

前記危険判定手段は、前記危険な状態にあるか否かの判定を、前記対象領域内の位置毎に設定された判定基準に基いて行なうように構成され；

前記対象領域が、前記対象物の体動及び移動に基づく振幅が大きい動きが検出されなくなったときに前記危険判定手段により前記危険な状態にあると判定される第１の領域と、前記対象物の呼吸に基づく振幅が小さい動きが乱れたとき若しくは検出されなくなったとき又は前記対象物の呼吸に基づく振幅が小さい動きが検出されない状態が所定時間継続したとき又は短時間に前記対象物の体動が頻出したときに前記危険判定手段により前記危険な状態にあると判定される前記第１の領域とは異なる第２の領域とを有し；

前記判定基準は、前記位置検出手段により前記対象物が前記第１の領域にあることを検

出したときは前記対象物の体動及び移動に基づく振幅が大きい動きが検出されなくなったときに前記危険な状態にあると判定し、前記位置検出手段により前記対象物が前記第２の領域にあることを検出したときは前記対象物の呼吸に基づく振幅が小さい動きが乱れたとき若しくは検出されなくなったとき又は前記対象物の呼吸に基づく振幅が小さい動きが検出されない状態が所定時間継続したとき又は短時間に前記対象物の体動が頻出したときに前記危険な状態にあると判定するように構成された；

空間内監視装置。

【請求項２】

前記動き検出手段による前記呼吸の検出が、前記高さ変化検出手段により検出された前記高さの変化の周期的変化の振幅と周期の両方又はいずれか一方に所定の上限下限の閾値を設定し、この閾値と比較して呼吸か否かを判定し、呼吸を検出するように構成された；

請求項１に記載の空間内監視装置。

【請求項３】

前記判定基準は、前記位置検出手段により前記対象物が前記第１の領域にあることを検出したときであって、前記第１の領域の出入口付近で前記対象物の移動が検出された後に前記対象物の動きが検出されなくなったときには、危険な状態と判定しないように構成された；

請求項１又は請求項２に記載の空間内監視装置。

【請求項４】

前記対象領域が浴室であり；

前記第１の領域が洗い場であり；

前記第２の領域が浴槽である；

請求項１乃至請求項３のいずれか１項に記載の空間内監視装置。

【請求項５】

前記対象領域がトイレであり；

前記第１の領域が出入口近傍の位置であり；

前記第２の領域が便器近傍の位置である；

請求項１乃至請求項３のいずれか１項に記載の空間内監視装置。

【請求項６】

前記３次元センサは、前記対象領域に、輝線又は、複数の輝点を投影する投影手段と；

前記投影により形成されたパターンを撮像する撮像手段と；

前記撮像されたパターン像と参照像とに基づいて三角法により前記対象物の高さを演算する高さ演算部とを備える；

請求項１乃至請求項５のいずれか１項に記載の空間内監視装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】

本発明は、対象物を監視する空間内監視装置に関し、特に空間内に存在する対象物の位置や動きなどの変化を監視するための空間内監視装置に関するものである。

【０００２】

【従来の技術】

空間内、例えば風呂場やトイレ等での対象物、例えば人物の動きの変化を監視する監視装置として、従来から、動き検出センサが提案されている。代表的な例は、浴室内の画像を撮像し、取得した画像を複数の部分画像に分けて、各部分画像毎に明るさと色の変化から対象物の動きがあるかどうかを検出し、各部分画像の動きの状況により、入浴中の人物が動いているか否かを判定する物である。また、室内用では、転倒を含む個室内の人物の状態を検出する装置として、天井に取り付けた赤外線画像センサと、壁面に取り付け一定の高さを検知エリアとする熱線高さセンサを組み合わせて相互の出力から室内の人物の状態を判定する装置が提案されている。この装置は、壁面のセンサの検出高さエリアを適当に設定することにより、在室中の人物が低い姿勢をとっているか、高い姿勢をとっているか

、即ち、転倒状態にあるか、そうでないかを検出することができる。

【０００３】

また、ベッド上の就寝者にパターンを投影し、投影されたパターンを連続的に撮像した画像からパターンの移動量を算出することで、就寝者の呼吸を監視する監視装置があった（例えば、特許文献１参照。）。

【０００４】

【特許文献１】

特開２００２－１７５５８２号公報　（第５－９頁、第１－１３図）

【０００５】

【発明が解決しようとする課題】

しかしながら以上のような従来の装置によれば、例えば人物の動きが止まっている場合には、ただじっとしている状態であるのか、倒れて危険な状態であるのかを判定することができなかった。

【０００６】

そこで本発明は、対象物の危険な状態を正確に判定するだけでなく、単純な空間内監視装置を提供することを目的としている。

【０００７】

【課題を解決するための手段】

上記目的を達成するために、請求項１に係る発明による空間内監視装置１は、例えば図１、図２に示すように、対象領域３内の３次元情報を取得する１つの３次元センサ１０と；前記取得した３次元情報に基づいて、対象領域３内の高さの変化を検出する高さ変化検出手段２２と；前記検出された高さの変化に基づいて、呼吸、体動及び移動をする対象物２の位置を検出する位置検出手段２３と；前記検出された高さの変化に基づいて、対象物２の呼吸、体動及び移動の動きを検出する動き検出手段２４と；前記検出された対象物２の位置と動きに基づいて、対象物２が危険な状態にあるか否かを判定する危険判定手段２５とを備え；危険判定手段２５は、前記危険な状態にあるか否かの判定を、対象領域３内の位置毎に設定された判定基準に基いて行なうように構成され；対象領域３が、対象物２の体動及び移動に基づく振幅が大きい動きが検出されなくなったときに危険判定手段２５により前記危険な状態にあると判定される第１の領域７と、対象物２の呼吸に基づく振幅が小さい動きが乱れたとき若しくは検出されなくなったとき又は対象物２の呼吸に基づく振幅が小さい動きが検出されない状態が所定時間継続したとき又は短時間に対象物２の体動が頻出したときに危険判定手段２５により前記危険な状態にあると判定される第１の領域７とは異なる第２の領域４とを有し；前記判定基準は、位置検出手段２３により対象物２が第１の領域７にあることを検出したときは対象物２の体動及び移動に基づく振幅が大きい動きが検出されなくなったときに前記危険な状態にあると判定し、位置検出手段２３により対象物２が第２の領域４にあることを検出したときは対象物２の呼吸に基づく振幅が小さい動きが乱れたとき若しくは検出されなくなったとき又は対象物２の呼吸に基づく振幅が小さい動きが検出されない状態が所定時間継続したとき又は短時間に対象物２の体動が頻出したときに前記危険な状態にあると判定するように構成される。

【０００８】

このように構成すると、３次元センサ１０と、高さ変化検出手段２２と、位置検出手段２３と、動き検出手段２４とを備えているので、対象物２の位置と、動きを検出できる。さらに、危険判定手段２５を備え、危険判定手段２５は、前記危険な状態にあるか否かの判定を、対象領域３内の位置毎に設定された判定基準に基いて行なうように構成されるので、対象物の危険な状態を正確に判定するだけでなく、単純な空間内監視装置を提供することができる。

【０００９】

上述のように、請求項１に記載の空間内監視装置１では、対象物２は、呼吸、体動及び移動をするものであり；動き検出手段２４は、対象物２の呼吸、体動及び移動を検出するように構成される。またこの場合には、呼吸、体動及び移動をする対象物２は、例えば人

物であるが、動物であってもよい。
【００１０】
このように構成すると、動き検出手段２４は、対象物２の呼吸を検出するので、例えば、対象物の動きがほとんど無い場合でも、呼吸を検出することで、その安否を判定できる。即ち、対象物の危険な状態を判定できる。また、検出された呼吸からも、その呼吸の正常、異常を判定することで、対象物２の危険な状態を判定することもできるので、危険な状態の判定の信頼性が増す。
【００１１】
上述のように、請求項１に記載の空間内監視装置１では、動き検出手段２４は、対象物２の移動を検出できる。
また請求項２に記載のように、請求項１に記載の空間内監視装置１では、動き検出手段２４による前記呼吸の検出が、高さ変化検出手段２２により検出された前記高さの変化の周期的変化の振幅と周期の両方又はいずれか一方に所定の上限下限の閾値を設定し、この閾値と比較して呼吸か否かを判定し、呼吸を検出するように構成するとよい。
また請求項３に記載のように、請求項１又は請求項２に記載の空間内監視装置１では、前記判定基準は、位置検出手段２３により対象物２が第１の領域７にあることを検出したときであって、第１の領域７の出入口付近で対象物２の移動が検出された後に対象物２の動きが検出されなくなったときには、危険な状態と判定しないように構成するとよい。
また請求項４に記載のように、請求項１乃至請求項３のいずれか１項に記載の空間内監視装置１では、例えば図１に示すように、前記対象領域が浴室３であり；前記第１の領域が洗い場７であり；前記第２の領域が浴槽４であるとよい。
また請求項５に記載のように、請求項１乃至請求項３のいずれか１項に記載の空間内監視装置１では、例えば図６に示すように、前記対象領域がトイレ２０３であり；前記第１の領域が出入口近傍の位置２０７’であり；前記第２の領域が便器近傍の位置２０４’であるとよい。
【００１２】
また、請求項１乃至請求項５のいずれか１項に記載の空間内監視装置１では、位置検出手段２３は、前記検出された高さ変化に基づいて、対象物２の存在する存在領域を判定し、前記判定された存在領域を含む領域であって、前記存在領域を所定の範囲だけ拡大した領域を算出し、前記拡大された領域を優先して、対象物２の位置の検出を行なうように構成するとよい。
【００１３】
このように構成すると、例えば、対象物２の存在する可能性が高い領域から対象２の位置の検出を行なうので、対象物２の位置の検出に要する時間を短縮でき、処理の高速化が図れる。
【００１４】
また請求項６に記載のように、請求項１乃至請求項５のいずれか１項に記載の空間内監視装置１では、例えば図７、図１１に示すように、３次元センサ１０１は、前記対象領域に、輝線又は、複数の輝点を投影する投影手段１１０、２１０と；前記投影により形成されたパターンを撮像する撮像手段１１１と；前記撮像されたパターン像と参照像とに基づいて三角法により前記対象物の高さを演算する高さ演算部１１８とを備える。
【００１５】
このように構成すると、３次元センサ１０１は、投影手段１１０、２１０により前記対象領域に投影された輝線又は、複数の輝点により形成されたパターンを、撮像手段１１１により撮像し、高さ演算部１１８により、前記撮像されたパターン像と参照像とに基づいて三角法により前記対象物の高さを演算するので、単純でありながら正確に対象物の高さを測定できる。また、パターンを輝線とした場合には、例えば、輝線方向の連続的な高さを測定できる。
【００１６】
【発明の実施の形態】

以下、本発明の実施の形態について、図面を参照して説明する。なお、各図において互いに同一あるいは相当する部材には同一符号を付し、重複した説明は省略する。

【００１７】

図１は、本発明による第１の実施の形態である空間内監視装置としての室内監視装置１の模式的外観図である。室内監視装置１は、浴室に設置されるものである。室内監視装置１は、対象領域内の３次元情報を取得する３次元センサ１０と、演算装置２０とを含んで構成される。また室内監視装置１は、対象領域を監視するように構成されている。また対象物は、呼吸をするものである。即ち対象物は、例えば人物や動物である。本実施の形態では、対象物は、人物２である。また本実施の形態では、対象領域は、浴室３である。また、３次元センサ１０は、対象領域内に複数の測定点を有しており、各測定点での高さを測定できるものである。また本実施の形態では、３次元情報は、浴室３内に複数存在する測定点の座標と、各点で測定された高さである。言い換えれば、３次元情報は、浴室３内での高さ分布である。

【００１８】

浴室３は、四方を壁面６に囲まれた閉空間であり、上方に天井５が形成されている。壁面６は、正面壁面６１、左側面壁面６２、裏面壁面６３、右側面壁面６４（以下単に壁面６１、６２、６３、６４という、また区別しないときは単に壁面６という）で構成されている。さらに浴室３は、浴槽４と、洗い場７とを有している。そして、浴槽４は洗い場７と隣接して設置されている。

【００１９】

また、浴室３の上部には、３次元センサ１０が配置されている。浴室３の上部とは、典型的には天井５又は、壁面６の上部である。図示は、天井５と壁面６とが形成する角部に配置している場合を示している。３次元センサ１０については後で詳述する。３次元センサ１０と演算装置２０とは電気的に接続されている。なお、図示では、３次元センサ１０と演算装置２０とは別体として示してあるが、一体に構成してもよい。このようにすると、室内監視装置１を小型化することができる。

【００２０】

図２のブロック図を参照して、室内監視装置１の構成例について説明する。３次元センサ１０は、演算装置２０に接続されており、取得した３次元情報を演算装置２０に出力するように構成されている。また演算装置２０は、３次元情報を３次元センサ１０から時系列的に取得するように構成するとよい。演算装置２０は、例えばパソコンやマイコン等のコンピュータである。また、演算装置２０は室内監視装置１を制御する制御部２１を有している。

【００２１】

制御部２１には、記憶部３１が接続されている。記憶部３１は、３次元センサ１０より時系列的に取得した３次元情報を記憶するようにするとよい。また記憶部３１には算出された情報等のデータが記憶できる。さらに、記憶部３１は、後述する浴室３内の位置毎に設定した判定基準が記憶される判定基準記憶部３２を有している。

【００２２】

また制御部２１には、室内監視装置１を操作するための情報を入力する入力装置３５、室内監視装置１で処理された結果を出力する出力装置３６が接続されている。入力装置３５は例えばタッチパネル、キーボードあるいはマウスであり、出力装置３６は例えばディスプレイやプリンタである。本図では、入力装置３５、出力装置３６は演算装置２０に外付けするものとして図示されているが、内蔵されていてもよい。また、入力装置３５は、例えば対象領域内の監視（危険判定）の開始や解除を行なえるスイッチ、出力装置３６は、例えば動作インジケータとしてのＬＥＤとしてもよい。このようにすると、室内監視装置１を単純に構成できる。特に、３次元センサ１０と演算装置２０とを一体に構成する場合には、このように構成することが好ましい。このようにすることで、より単純で小型な室内監視装置とすることができる。

【００２３】

制御部２１内には、３次元センサ１０より取得した３次元情報に基づいて、浴室３内の高さの変化を検出する高さ変化検出手段としての高さ変化検出部２２と、高さ変化検出部２２により検出された高さの変化に基づいて、人物２の位置を検出する位置検出手段としての位置検出部２３と、高さ変化検出部２２により検出された高さの変化に基づいて、人物２の動きを検出する動き検出手段としての動き検出部２４と、検出された人物２の位置と動きに基づいて、人物２が危険な状態にあるか否かを判定する危険判定手段としての危険判定部２５とが備えられている。位置検出部２３により検出する人物２の位置は、例えば人物２の存在する領域の位置であり、人物２の存在領域の位置は、典型的には人物２の存在領域の重心位置である。また、人物２の動きを検出するとは、人物２に動きが無いことを検出することを含む概念である。また、ここでいう動きは、例えば、呼吸、体動、移動である。体動とは、人物２の体の動きであり、例えば立ったり座ったりといった動きの他、手足の動きを広く含む概念である。以下、各構成について説明する。

【００２４】

高さ変化検出部２２による高さの変化の検出は、３次元センサ１０から取得した３次元情報と、記憶部３１に時系列的に保存された３次元情報との差分を算出することにより浴室３内の各測定点での高さの変化を検出する。言い換えれば、取得した最新の３次元情報と、過去に取得した３次元情報との差分を取ることにより浴室３内の各測定点での高さの変化を検出する。過去に取得した３次元情報は、典型的には最新の３次元情報より１つ前（過去）に取得した３次元情報である。なお、この場合、３次元情報は、３次元センサ１０から一定時間間隔で取得するようにする。３次元情報の取得間隔は、例えば０．１～３秒程度、好ましくは０．１～０．５秒程度とするとよい。また、より短い時間で３次元情報を取得し、平均化またはフィルタリングの処理を行なうことで、例えばランダムノイズの影響を低減できるので有効である。また、取得間隔は、比較的長めな時間、例えば５～２０秒程度としてもよい。この場合には、例えば人物２の大きな体動を検出しやすくなる。

【００２５】

また、３次元センサ１０から取得した３次元情報又は高さ変化は、過去一定回数取得した、または過去一定期間内に取得した値の移動平均値、または期間平均値としてもよい。このようにすることで、ランダムノイズや窓から差し込む日光のちらつきなどによる突発的なノイズが軽減でき、ピーク位置の誤判定やゼロクロス位置（符号が反転する交点）の誤判断を軽減することができる。

【００２６】

また、位置検出部２３は、高さ変化検出部２２により検出された高さ変化に基づいて、人物２の存在する存在領域を判定し、前記判定された存在領域の重心位置を人物２の位置とするように構成するとよい。このようにすることで、人物２の位置を、面積のある領域ではなく、点で検出することができるので、人物２の僅かな動きを比較的敏感に検出することができる。

【００２７】

存在領域の判定は、例えば、任意の測定点の高さ変化に注目し、高さ変化が閾値以上であれば、この注目点から所定の範囲にある点で、高さ変化が閾値以上であり、変化の方向が注目位置と同じである測定点の数を計数し、そしてその数が所定の値以上であれば、この範囲を存在領域と見なすようにする。

【００２８】

さらに、位置検出部２３は、判定された存在領域を含む領域であって、存在領域を所定の範囲だけ拡大した領域を算出し、その拡大された領域を優先して、人物２の位置の検出を行なうように構成してもよい。本実施の形態では、３次元センサ１０による３次元情報の取得間隔は、人物２の動きと比較して十分短時間に設定されているので、人物２がこの取得間隔の間に大きく移動することはなく、次に人物２の位置を検出する際にも、人物２がほぼ同じ位置あるいは隣接した領域に存在すると考えられる。このため、存在領域を所定の範囲だけ拡大した領域を優先して人物２の位置の検出を行なう方法が有効である。このようにすることで、人物２が存在する可能性が高い領域を優先して、人物２の位置を検出

するので、人物２の探索時間が短縮でき、処理の高速化が図れる。
【００２９】
動き検出部２４は、前述したように、高さ変化検出部２２により検出された高さの変化に基づいて、人物２の動きを検出するものである。さらに、動き検出部２４は、高さ変化検出部２２により検出した高さの変化に基づいて、人物２の呼吸を検出するように構成される。
【００３０】
動き検出部２４による呼吸の検出は、高さ変化検出部２２により検出した高さ変化の周期的変化の振幅と周期（周波数）の両方又はいずれか一方に所定の上限下限の閾値を設定し、この閾値と比較して呼吸か否かを判定し、呼吸を検出する。周期の上限下限の閾値は、例えば人物の呼吸の周期を含む範囲、例えば、下限を毎分５サイクル、上限を毎分６０サイクルに設定するとよい。ところで、大人の呼吸数は、毎分５～３０回程度の範囲にあるが、幼児の場合にはさらに呼吸数が多くなる傾向がある。また同様に、振幅の上限下限の閾値は、例えば人物の呼吸の振幅を含む範囲、例えば、下限を１ｍｍ、上限を２０ｍｍ程度の高さ変化に相当する値に設定するとよい。これにより、検出された人物２の呼吸は、波形パターンを形成する。
図３は、呼吸の波形パターンの例を示した図である。
【００３１】
また、動き検出部２４は、検出された高さ変化が、所定値以上であれば、人物２に大きな動き即ち体動があった判定するように構成するとよい。所定値は、例えば１０ｍｍ以上、好ましくは２０ｍｍ以上に設定する。なお、後述の呼吸の範囲に重ならないように設定するようにする。また、所定値を複数設定し、設定した各所定値を越える毎に異なる動きが有ったと判定するようにしてもよい。このようにすることで、例えば、体動であっても、腕を動かすような小さな体動や、立ったり座ったりといった大きな体動を区別して判定できる。即ち人物２の動きをより細かく判定できる。人物２の体動の検出は、高さ変化から呼吸のみを検出した場合に比べて、高さ変化が遥かに大きく変動するので、容易に検出することができる。また、人物２が痙攣のような周期的で小さい動きをした場合でも、波形パターンからそれを検出することができる。このような場合には、さらに痙攣している動きの波形パターンを記憶部３１に保存しておくことで、そのパターンと比較することにより人物２の痙攣を検出することもできる。
【００３２】
また、動き検出部２４は、位置検出部２３により判定された存在領域内の高さ変化の平均値に基づいて、人物２の動きを検出するように構成してもよい。このようにすると、動き検出部２４による動きの検出の信頼性が向上する。
【００３３】
さらに、動き検出部２４は、人物２の移動を検出できるように構成されている。なお、移動の検出は、移動の有無の検出の他、移動の方向、速度、距離の検出を含むものとする。移動は、例えば、位置検出部２３により検出された人物２の位置の変化を検出することにより少なくとも移動の有無を検出できる。また、例えば、一定時間間隔で人物２の位置を取得することで、人物２の移動速度を容易に検出できる。
【００３４】
危険判定部２５は、位置検出部２３により検出された人物２の位置と、動き検出部２４により検出された人物２の動きに基づいて、人物２が危険な状態にあるか否かを判定するものである。さらに、危険判定部２５は、危険な状態にあるか否かの判定を、浴室３内の位置毎に設定された判定基準に基いて行なうように構成されている。ここでは、浴室３内の位置毎に設定された判定基準は、浴槽４の位置、洗い場７の位置毎に設定されている。
【００３５】
危険な状態の判定基準について説明する。危険な状態であると判定する基準は、例えば、洗い場７では、人物２の動きの振幅が大きい、言い換えれば体動（例えば背中を洗う時の手の動き等）が検出されている状態から、人物２の動きの振幅が小さくなったとき、急に

人物２の動きが無くなったとき、動きが無い状態が所定時間継続したときを基準とするとよい。これは、例えば人物２が転倒した、あるいは気絶したと推測できるためである。但し、洗い場７でも特に浴室３の出入口付近で移動が検出された後、人物２の動きが無くなったときには、危険な状態と判定しないようにする。これは、人物２が浴室３の外に出たと判定できるからである。このような判定基準とすると、例えば、人物２の動きの振幅が大きい、言い換えれば体動（例えば背中を洗う時の手の動き等）が検出されている場合には、危険な状態ではない（以下適宜安全状態という）と判定することになる。また、人物２が浴室３の外に出たと判定した場合には、再び浴室３内で人物２の動きが検出されるまで、浴室３内の監視を休止するように構成してもよい。このようにすると、例えば、人物２が浴室３内に存在しないにも関らず、ノイズ等を検出することで、誤判定を防ぐことができるので、信頼性が高い。

【００３６】
また、浴槽４では、急に人物２の動きが無くなったとき、動きが無い状態が所定時間継続したときを基準とするとよい。これは、例えば人物２が水没した、あるいは気絶していると推測できるためである。言い換えれば、このような判定基準とすると、人物２の呼吸を検出されている場合には、危険な状態ではない（以下適宜安全状態という）と判定することになる。

【００３７】
さらに、危険判定部２５による人物２の危険状態の判定の基準は、以下のようなことを考慮して、設定するようにするとよい。例えば、呼吸が検出されているときに、短時間に呼吸パターンの持つ周期が乱れた場合又は、呼吸パターンの持つ周期が急激に変化した場合には、例えば、自然気胸、気管支喘息などの肺疾患、うっ血性心不全などの心疾患、または、脳出血などの脳血管疾患であると推測できるので、危険な状態であると判定するように設定する。また、呼吸パターンの消失が続いた場合には、人物２の呼吸が停止したと推測できるので、危険な状態であると判定するように設定する。そして、短時間に呼吸パターンではなく人物２の体動が頻出した場合には、人物２が何らかの理由で苦しんで暴れているような状況が推測できるので、危険な状態であると判定するように設定する。

【００３８】
図４を参照して、正常及び異常な呼吸パターンの例を説明する。正常な呼吸パターンは、図４（ａ）に示したような、周期的なパターンである。ただし、大人の場合には、１分間の呼吸数として正常な範囲は、１０～２０回程度である。異常な呼吸パターンは、例えば、チェーン－ストークス（Ｃｈｅｙｎｅ－Ｓｔｏｋｅｓ）呼吸、中枢性過換気、失調性呼吸、カスマウル（Ｋｕｓｓｍｕｌ）の大呼吸など、生理学的に体内に障害が発生している場合に生じると考えられている呼吸パターンである。

【００３９】
図４（ｂ）に、Ｃｈｅｙｎｅ－Ｓｔｏｋｅｓ呼吸の呼吸パターンを、図４（ｃ）に中枢性過換気の呼吸パターンを、図４（ｄ）に失調性呼吸の呼吸パターンをそれぞれ示す。
さらに図５に、上記の異常な呼吸パターンが発生した場合の、病名または疾患箇所について示す。

【００４０】
危険判定部２５は、それぞれの呼吸パターンの呼吸の周波数、出現回数、深浅が異なることを利用して、人物２の呼吸パターンが上記のいずれの呼吸パターンに属するかを判別し、人物２の危険な状態を判定するようにするとよい。また以上のような呼吸パターンを、記憶部３１に保存しておくとよい。このようにすることで、これらのパターンと比較することで人物２の呼吸が正常であるか否かの判定が容易に行なえる。

【００４１】
さらに危険判定部２５は、人物２の呼吸が、生理学的に体内に障害が発生している場合に生じると考えられている呼吸パターンに属すると判定した場合に、人物２が異常な呼吸をしており危険な状態にあると判定する。生理学的に体内に障害が発生している場合に生じると考えられている呼吸パターンとは、例えば図４で説明した呼吸パターンである。この

ように判定された人物２の危険な状態は、例えば、制御部２１により出力装置３６や警報装置３８に出力するとよい。また出力される内容は、検出された人物２の呼吸数（周期）や動きの頻度、異常な呼吸パターンの名称やその呼吸の原因となると考えられる病名、疾患器官、疾患箇所などである。

【００４２】

図２に戻って説明する。さらに、危険判定部２５は、人物２が危険な状態にあると判定結果に基づいて、警報信号を出力するように構成される。警報信号は、典型的には後述の警報装置３８へ出力される。

【００４３】

ここで、危険判定部２５の出力する警報信号の例について説明する。危険判定部２５は、危険な状態と判定している状態が、第１の所定期間経過した際に第１の警報信号としての内部警報信号を出力し、第１の所定期間より長い期間の第２の所定期間経過した際に、第２の警報信号としての外部警報信号を出力するように構成してある。外部警報信号を出力する場合には、第２の所定期間内に内部警報信号が出力されたことが条件となる。第１の所定期間、第２の所定期間は、例えば時間で定めてもよいし、取得した３次元情報数で定めてもよい。時間で定めた場合には、第１の所定期間は、例えば、３～１５秒、好ましくは５～１０秒程度とし、第２の所定期間は、例えば、１０～３０秒、好ましくは１０～２０秒程度である。例えば、これをフレーム数で示した場合には、第１の所定期間を８秒、第２の所定期間を１５秒、３次元情報の取得間隔を毎秒１回とすると、内部警報信号は８回、外部警報信号は１５回である。また、危険判定部２５は、危険な状態と判定した回数が、所定の回数のうち、第１の回数あった際に第１の警報信号としての内部警報信号を出力し、第１の回数より多い回数の第２の回数あった際に第２の警報信号としての外部警報信号を出力するように構成してもよい。所定の回数は、例えば１５～２５回とした場合に、第１の回数は、５～１０回程度、第２の回数は、１０～２０程度とするとよい。

【００４４】

内部警報信号は、例えば、比較的軽度な警報例えば人物２に異常の有無を確認する、あるいは注意を促す為のものである。室内監視装置１は、危険判定部２５が、内部警報信号を出力した際には、警報装置３８により、例えば、浴室３に備えられた不図示のスピーカから、「大丈夫ですか」等のメッセージを音声出力するように構成される。外部警報信号は、内部警報信号と比較して重度な警報信号である。以下、内部警報信号と外部警報信号とを特に区別しないときには、単に警報信号という。

【００４５】

さらに、演算装置２０は、警報を発する警報装置３８を備える。警報装置３８は、警報信号を入力することで、警報を発するように構成される。警報装置３８は、例えば危険判定部２５により人物２が危険な状態であると判定されたとき、あるいは室内監視装置１に故障等の異常が発生したときに警報を発するように構成するとよい。また、警報装置３８は、入力した警報信号に応じて、異なる種類の警報を発するように構成される。具体的には、例えば、入力した警報信号の種類毎に異なる警報を設定する。言い換えれば、警報装置３８は、入力した内部警報信号と、外部警報信号とで、それぞれ異なる警報を発するように設定する。これにより、例えば、装置の使用者（管理者）が、発せられた警報により、例えば人物２が危険な状態にあることを容易に認知できる。このようにすることで、異常に対して迅速に対応できるので、信頼性を高めることができる。また、演算装置２０は、警報装置３８が作動した場合に、インターフェイス３７を介して、警報の発生を外部に通報するように構成するとよい。本図では、警報装置３８は、外付けとして図示してあるが内蔵としてもよい。

【００４６】

また演算装置２０は、外部と通信するためのインターフェイス３７が備えられている。インターフェイス３７は、例えば警報装置３８により警報が発せられた場合に外部に通報することができるように構成されている。通報は、例えば音声、文字、記号、室内照明を含む光の強弱又は、振動などによるものである。またインターフェイス３７は、一般電話回

線、ＩＳＤＮ回線、ＰＨＳ回線、または、携帯電話回線などの通信回線に対して接続する機能を備えている。即ち、例えば室内監視装置１が個人宅に設置されている場合には、上記通信回線を利用することで、離れた場所例えば病院等の医療施設に通報できる。このようにすることで、例えば室内監視装置１が設置された場所から離れた場所であっても、上記通信回線を利用することで、警報が発せられたこと容易に通報できるので、有効である。また制御部２１は、音声出力機能を備えるようにし、インターフェイス３７を介して、第三者に例えば警報や人物２の状態を音声で通報するようにしてもよい。

【００４７】

以上のような第１の実施の形態の室内監視装置１によれば、浴室でも、人物２の位置、動きを検出して、人物２の倒れ等の危険な状態を確実かつ迅速に判定することができる。また、浴槽での水没状態を検出できるので、早期発見が可能である。また、洗い場に人物２がいるときは、倒れを検出しても、浴室内への呼びかけをゆっくり行ない、不要な呼びかけや通報を低減し、浴槽に人物２がいるときは、迅速な通報を優先する等、人物２の居場所によって、対応を選択することが可能であり、安静で快適な浴室の利用と救急対応とが両立できる。

【００４８】

以上では、室内監視装置は、浴室３に適用する場合を例として説明したが、室内監視装置の適用は、上記に限られず、例えばトイレ、一般家庭の室内、寝室あるいは病院の病室であってもよい。以下、室内監視装置をトイレに設置する場合の例について説明する。

【００４９】

図６は、本発明による第２の実施の形態である空間内監視装置としての室内監視装置２０１の模式的外観図である。室内監視装置２０１は、前述した室内監視装置１と同様な構成である。本実施の形態では、対象領域は、トイレ２０３である。

【００５０】

トイレ２０３は、浴室３同様に四方を壁面に囲まれた閉空間である。トイレ２０３は、便器２０４が出入口２０６と対面する壁面側に近接して配置されている。言い換えれば、便器２０４は、トイレ２０３の奥に設置されている。また、トイレ２０３の上部には、３次元センサ１０が配置されている。トイレ２０３の上部とは、典型的には天井又は、壁面の上部である。図示は、天井と壁面とが形成する角部に配置している場合を示している。

【００５１】

また、図２で前述した危険判定部２５は、同様に構成されるが、ここでは、位置毎に設定された判定基準は、便器２０４近傍の位置２０４’、出入口近傍の位置２０７’毎に設定するとよい。

【００５２】

ここで、室内監視装置２０１の場合の危険な状態の判定基準について説明する。危険な状態であると判定する基準は、例えば、出入口近傍の位置２０７’では、人物２の動きの振幅が大きい、言い換えれば体動（例えば出入口２０６から便器２０４に移動する動き等）が検出されている状態から、人物２の動きの振幅が小さくなったとき、急に人物２の動きが無くなったとき、動きが無い状態が所定時間継続したときを基準とするとよい。これは、室内監視装置１で前述したのと同様に、例えば人物２が転倒した、あるいは気絶したと推測できるためである。また、同様に、出入口２０６への移動が検出された後、人物２の動きが無くなったときには、危険な状態と判定しないようにする。これは、人物２がトイレ２０３の外に出たと判定できるからである。

【００５３】

また、便器２０４近傍の位置２０４’では、急に人物２の動きが無くなったとき、動きが無い状態が所定時間継続したときを基準とするとよい。これは、例えば人物２が気絶していると推測できるためである。言い換えれば、このような判定基準とすると、人物２の呼吸を検出されている場合には、危険な状態ではないと判定することになる。即ち、例えば人物２が用を足しているとき（便器２０４の便座に座っているときや、便器２０４の前に立っているとき）には、基本的に前述の浴槽４の場合と同様に、人物２は体動しない（安

静状態）ので、大きな動きがなくても、呼吸が検出されれば、安全状態を推測できる。なお、呼吸の判定については、室内監視装置１と同様であるので説明を省略する。

【００５４】

以上のような第２の実施の形態の室内監視装置２０１は、対象領域としてのトイレ内にどの程度の大きさの人物２が進入し、人物２がどのようなの状態（どの位置で、立っている、座っている、倒れている）にあるか、また、その人物２は動いているか、また退出したかといった一連の動きを追従することができる。

【００５５】

ここで３次元センサ１０について説明する。３次元センサ１０は、典型的には非接触で対象領域内の３次元情報を取得できるものである。以下、本実施の形態で、３次元センサとして用いるＦＧセンサについて説明する。

【００５６】

図７の概念的斜視図を参照して、本実施の形態の室内監視装置１、２０１に適した３次元センサ１０として用いるＦＧ（ファイバーグレーティング）センサ１０１について説明する。ＦＧセンサ１０１は、対象領域内に存在する対象物（人物２）の３次元情報を取得できるものである。即ち、対象物の高さの分布を測定できるように構成されたものである。ここでは、説明のために、対象領域内を平面１０２、対象物を物体１０３として説明する。

【００５７】

ＦＧセンサ１０１は、対象領域に、複数の輝点を投影する投影手段としての輝点投影装置１１０と、輝点投影装置１１０の投影により形成されたパターン１１０ａを撮像する撮像手段としての撮像装置１１１とを備えている。パターン１１０ａは、典型的には正方格子状に配列された複数の輝点である。また、輝点の形状は楕円形を含む略円形である。

【００５８】

図中物体１０３が、平面１０２上に載置されている。またＸＹ軸を平面１０２内に置くように、直交座標系ＸＹＺがとられており、物体１０３はＸＹ座標系の第１象限に置かれている。一方、図中Ｚ軸上で平面１０２の上方には、輝点投影装置１１０と、撮像装置１１１とが配置されている。撮像装置１１１は、輝点投影装置１１０によりパターン１１０ａが投影された物体１０３を撮像する。

【００５９】

撮像装置１１１は、結像レンズ１１１ａと、撮像素子１１５とを有している。撮像素子１１５は、典型的にはＣＣＤカメラである。撮像装置１１１の結像レンズ１１１ａは、典型的にはその光軸がＺ軸に一致するように配置されている。そして、結像レンズ１１１ａは、平面１０２あるいは物体１０３上のパターン１１０ａの像を、撮像素子１１５の結像面１１５’（イメージプレーン）に結像する。結像面１１５’は、典型的にはＺ軸に直交する面である。さらに、結像面１１５’内にｘｙ直交座標系をとり、Ｚ軸が、ｘｙ座標系の原点を通るようにする。平面２から結像レンズ１１１ａと等距離で、結像レンズ１１１ａからＹ軸の負の方向に距離ｄ（基線長ｄ）だけ離れたところに、輝点投影装置１１０が配置されている。物体１０３と平面１０２には、輝点投影装置１１０により複数の輝点１１０ｂが形成するパターン１１０ａが投影される。また、ｙ軸方向は、図９で後述する高さの演算に用いる三角法の基線方向でもある。

【００６０】

撮像素子１１５は、典型的にはＣＣＤ撮像素子である。また、ＣＣＤの他にＣＭＯＳ構造の素子が最近盛んに発表されており、それらも当然使用可能である。特にこれらの中には、素子自体にフレーム間差算や二値化の機能を備えたものがあり、これらの素子の使用は好適である。

【００６１】

また、撮像素子１１５には、制御装置１１４が接続されている。言い換えれば、撮像装置１１１は制御装置１１４に接続されている。制御装置１１４は、ＦＧセンサ１０１全体を制御するものである。また、制御装置１１４は、典型的には撮像装置１１１と別体に設置

されるが、一体に構成してもよい。このようにすると、装置の小型化が図れる。制御装置１１４は典型的にはパソコン等のコンピュータである。また制御装置１１４内には、撮像装置１１１により撮像されたパターンの像を取得する画像処理装置１１７が組み込まれている。

【００６２】

さらに制御装置１１４内には、撮像装置１１１により撮像されたパターン像と参照像とに基づいて三角法により対象物としての物体１０３の高さを演算する高さ演算部１１８が組み込まれている。ここで、参照像とパターン像は、例えば撮像装置１１１により撮像された像であるが、参照像とパターン像のそれぞれの撮像素子１１５（又は結像面１１５’）上での位置の情報も含む概念である。即ち、参照像とパターン像は、輝点投影装置１１０の投影により形成されたパターン１１０ａの像である。ここでは、参照像は、物体１０３が平面１０２に存在しないときのパターン１１０ａの像であり、パターン像は、物体１０３が平面１０２に存在しているときのパターン１１０ａの像である。即ち、参照像は、パターン１１０ａの各輝点１１０ｂの基準位置を示す像である。また、参照像は、画像処理装置１１７に予め保存しておくとよい。ここでは、参照像は、例えば、いわゆる像としてではなく、各輝点１１０ｂの位置に関する、座標等の位置の情報の形で保存するようにするとよい。このようにすると、後述するパターン像と参照像に基づいて輝点の移動量を検出する際に、例えば輝点の座標や方向を比較するだけで済むので処理が単純になる。

【００６３】

撮像装置１１１は、後述の光束発生部１０５（図１０参照）により発生されるレーザ光束Ｌ１の波長の周辺部以外の波長の光を減光するフィルタ１１１ｂを備えるとよい。フィルタ１１１ｂは、典型的には干渉フィルタ等の光学フィルタであり、結像レンズ１１１ａの光軸上に配置するとよい。このようにすると、撮像装置１１１は、撮像素子１１５に受光する光のうち、輝点投影装置１１０より投影されたパターン１１０ａの光の強度が相対的にあがるので、外乱光による影響を軽減できる。また、光束発生部１０５により発生されるレーザ光束Ｌ１は、典型的には赤外光レーザの光束である。また、レーザ光Ｌ１は、継続的に照射してもよいし、断続的に照射してもよい。断続的に照射する場合には、撮像装置１１１による撮像を、照射のタイミングに同期させて行なうようにする。

【００６４】

また、ＦＧセンサ１０１は、撮像装置１１１によりパターン１１０ａを撮像する際に、外乱光と区別するために、変調を行なうように構成するとよい。変調は、例えば光束発生部１０５によるレーザ光束Ｌ１の発光（照射）停止を周期的に繰り返し行なうような動作である。この場合、レーザ光束Ｌ１の発光停止は、例えば光源を発光停止してもよいし、遮光板やスリットを回転させることにより、発光停止をするようにしてもよい。この場合、この変調に同期した受光信号を取り出すことにより、外乱光の影響を著しく低減することができる。さらに変調は、上述に加え、外乱光の強さにより、レーザ光束Ｌ１の出力も変化させるようにしてもよい。また、画像処理装置１１７は、レーザ光束Ｌ１を照射している時の受光信号からレーザ光束Ｌ１を照射していない時の受光信号を差し引いた信号を生成するようにしてもよい。これにより、外乱光の影響を低減することができる。さらに、ＦＧセンサ１０１は、信頼性を確保するために、変調動作を複数回行ない、その平均の出力信号を取得データ即ちパターン像とするように構成してもよい。

【００６５】

ここで、図７を参照して、ＦＧセンサ１０１の作用を説明する。まず、物体１０３の高さの計測の概念について説明する。輝点投影装置１１０により平面１０２に投影されたパターン１１０ａは、物体１０３が存在する部分では、物体１０３に遮られ平面１０２には到達しない。ここで物体１０３が存在していれば、平面１０２上の点１０２ａに投射されるべき輝点１１０ｂは、物体１０３上の点１０３ａに投射される。輝点１１０ｂが点１０２ａから点１０３ａに移動したことにより、また結像レンズ１１１ａと輝点投影装置１１０とが距離ｄ（基線長ｄ）だけ離れているところから、結像面１１５’上では、点１０２ａ’（ｘ，ｙ）に結像すべきところが点１０３ａ’（ｘ，ｙ＋δ）に結像する。即ち、物体

１０３が存在しない時点と物体１０３が存在する時点とは、輝点１１０ｂの像がｙ軸方向に距離δだけ移動することになる。
【００６６】
これは、例えば図８に示すように、撮像素子１１５の結像面１１５’に結像した輝点１１０ｂの像は、高さのある物体１０３により、δだけｙ軸方向に移動することになる。
【００６７】
ＦＧセンサ１０１は、このδを計測することにより、物体１０３上の点１０３ａの位置が三次元的に特定できる。即ち、点１０３ａの高さがわかる。このように、ある点が、物体１０３が存在しなければ結像面１１５’上に結像すべき点と、結像面１１５’上の実際の結像位置との差を計測することにより、物体１０３の高さの分布、言い換えれば３次元形状が計測できる。あるいは物体１０３の３次元座標が計測できる。また、輝点１１０ｂの対応関係が不明にならない程度に、パターン１１０ａのピッチ、即ち輝点１１０ｂのピッチを細かくすれば、物体１０３の高さの分布はそれだけ詳細に計測できることになる。
【００６８】
ここで、高さ演算部１１８による高さの演算について説明する。高さ演算部１１８は、パターン像と参照像を読出し、輝点１１０ｂの像の移動量δを計測する。移動量δの計測は、まずパターン像と参照像の差画像を作成する。そして、この差画像から対応する輝点の像の位置の移動量δを計測する。移動量δは、例えば、輝点１１０ｂの像の位置が移動した画素数（何画素移動したか）を計数することで求められる。なお、上記は、差画像を作成する場合で説明したが、参照像を各輝点１１０ｂの位置の情報の形で保存しておき、パターン像の各輝点１１０ｂの位置の情報と、参照像の輝点１１０ｂの位置の情報とを比較することで、移動量δを計測してもよい。このようにすると、差画像を生成しないで済むので処理を単純化できる。高さ演算部１１８は、移動量δに基づいて三角法により物体３の高さを演算する。図９を参照して、三角法による物体１０３の高さの算出について説明する。
【００６９】
図９は、撮像装置１１１、輝点投影装置１１０、物体１０３、平面１０２との関係をＸ軸方向（図７参照）に見た側面図である。ここでは、物体１０３の高さがＺ１である場合で説明する。輝点投影装置１１０の中心（パターン光源の中心）と結像レンズ１１１ａの中心とは、平面１０２に平行に距離ｄだけ離して配置されており、結像レンズ１１１ａから結像面１１５’（撮像素子１１５）までの距離はｌ（エル）（結像レンズ１１１ａの焦点とほぼ等しい）、結像レンズ１１１ａから平面１０２までの距離はｈ、物体１０３の点１０３ａの平面１０２からの高さはＺ１である。物体１０３が平面１０２上に置かれた結果、結像面１１５’上の点１０２ａ’はδだけ離れた点１０３ａ’に移動したとする。
【００７０】
図中結像レンズ１１１ａの中心と点１０３ａとを結ぶ線が平面１０２と交差する点を１０２ａ”とすれば、点１０２ａと点１０２ａ”との距離Ｄは、三角形１０３ａ’－１０２ａ’－１１１ａと三角形１０２ａ”－１０２ａ－１１１ａとに注目すれば、Ｄ＝δ・ｈ／ｌであり、三角形１１１ａ－１１０－１０３ａと三角形１０２ａ”－１０２ａ－１０３ａに注目すれば、Ｄ＝（ｄ・Ｚ１）／（ｈ－Ｚ１）である。この両式からＺ１を求めると次式のようになる。
$Z1 = (h^2 \cdot \delta) / (d \cdot l + h \cdot \delta)$　………（１）
以上のように、物体１０３の高さを算出することができる。
【００７１】
さらに、高さ演算部１１８により演算された物体１０３の高さは、過去一定回数演算された、または過去一定期間内に演算された高さの移動平均値、または期間平均値としてもよい。このようにすることで、ランダムノイズや窓から差し込む日光のちらつきなどによる突発的なノイズが軽減でき、演算した物体１０３の高さの信頼性が向上する。
【００７２】
以上のように、ＦＧセンサ１０１は、対象領域に、輝点投影装置１１０の投影により形成

されたパターン１１０ａを撮像装置１１１で撮像し、この撮像されたパターン像と参照像とに基づいて三角法により対象物の高さを高さ演算部１１８で演算するので、対象物の高さを計測できる。また、ＦＧセンサ１０１は、対象物の高さを対象領域内の複数の点で計測できるので、対象物の高さの分布を計測することができる。また、この高さの分布を、例えば一定時間間隔で計測することで、高さ分布の時間変化を計測することもできる。

【００７３】

さらに、図１０の模式的斜視図を参照して、ＦＧセンサ１０１に適した輝点投影装置１１０について説明する。輝点投影装置１１０は、可干渉性の光束を発生する光束発生手段としての光束発生部１０５と、ファイバーグレーティング１２０（以下、単にグレーティング１２０という）とを備えている。可干渉性の光束は、典型的には赤外光レーザである。光束発生部１０５は、平行光束を発生するように構成されている。光束発生部１０５は、典型的には不図示のコリメータレンズを含んで構成される半導体レーザ装置であり、発生される平行光束は、レーザ光束Ｌ１である。そしてレーザ光束Ｌ１は、断面が略円形状の光束である。ここで平行光束とは、実質的に平行であればよく、平行に近い光束も含む。

【００７４】

またここでは、グレーティング１２０は、平面１０２に平行に（Ｚ軸に直角に）配置される場合で説明する。グレーティング１２０に、レーザ光Ｌ１を、Ｚ軸方向に入射させる。するとレーザ光Ｌ１は、個々の光ファイバー１２１により、そのレンズ効果を持つ面内で集光したのち、発散波となって広がって行き、干渉して、投影面である平面１０２にパターン１１０ａが投影される。なお、グレーティング１２０を平面１０２に平行に配置するとは、例えば、グレーティング１２０を構成するＦＧ素子１２２の各光ファイバー１２１の軸線を含む平面と、平面１０２とが平行になるように配置することである。

【００７５】

グレーティング１２０は、２つのＦＧ素子１２２を含んで構成される。本実施の形態では、各ＦＧ素子１２２の平面は、互いに平行である。以下、各ＦＧ素子１２２の平面を素子平面という。また、本実施の形態では、２つのＦＧ素子１２２の光ファイバー１２１の軸線は、互いにほぼ直交している。

【００７６】

ＦＧ素子１２２は、例えば、直径が数１０ミクロン、長さ１０ｍｍ程度の光ファイバー１２１を数１０～数１００本程度、平行にシート状に並べて構成したものである。また、２つのＦＧ素子１２２は、接触して配置してもよいし、それぞれの素子平面の法線方向に距離を空けて配置してもよい。この場合には、２つのＦＧ素子１２２の互いの距離は、パターン１１０ａの投影に差支えない程度とする。レーザ光束Ｌ１は、典型的には、グレーティング１１０の素子平面に対して垂直に入射させる。

【００７７】

以上のように、輝点投影装置１１０は、２つのＦＧ素子１２２を含んで構成されたグレーティング１２０が光学系となるので、複雑な光学系を必要とすることなく、光学筐体を小型化できる。さらに輝点投影装置１１０は、グレーティング１２０を用いることで、単純な構成で、複数の輝点１１０ｂをパターン１１０ａとして平面１０２に投影できる。

【００７８】

また、以上では、パターンを複数の輝点として説明したが、複数の輝線としてもよい。即ち光切断法を用いて対象物の高さを測定するようにしてもよい。この場合には、輝点投影装置１１０の代わりに、対象領域に、輝線を投影する投影手段としての輝線投影装置２１０を備えるようにする。輝線投影装置２１０により投影する輝線の数は、典型的には複数であるが、１本であってもよい。以下、輝線は複数の場合で説明する。以下、ＦＧセンサ１０１に光切断法を用いた場合のものをＦＧセンサ１０１’として説明する。

【００７９】

図１１の模式的概念図を参照して、ＦＧセンサ１０１’について説明する。輝線投影装置２１０は、平面１０２に、輝線２１０ｂを平行に複数本投影する。撮像装置１１１は、輝線投影装置２１０によりパターン２１０ａが投影された物体１０３及び平面１０２を撮像

する。輝線２１０ｂは、等間隔に複数本投影される。複数本の輝線２１０ｂは、パターン２１０ａを形成する。また、輝線２１０ｂの方向と三角法の基線方向は、ほぼ垂直である。即ち、輝線２１０ｂの方向は、ｙ軸に垂直である。またここでは、輝線は複数本としているが、１本であってもよい。この場合には、ＦＧセンサ１０１’をさらに単純に構成できる。

【００８０】

ここで、光切断法を用いた物体１０３の高さ計測の概念について説明する。輝線投影装置２１０により平面１０２に投影されたパターン２１０ａは、物体１０３が存在する部分では、物体１０３に遮られ平面１０２には到達しない。ここで物体１０３が存在しなければ、平面１０２上の点１０２ａに投射されるべき輝線は、物体１０３上の点１０３ａに投射される。輝線が点１０２ａから点１０３ａに移動したことにより、また結像レンズ１１１ａと輝線投影装置２１０とが距離ｄ（基線長ｄ）だけ離れているところから、結像面１１５’上では、点１０２ａ’（ｘ，ｙ）に結像すべきところが点１０３ａ’（ｘ，ｙ＋δ）に結像する。即ち、物体１０３が存在しない時点と物体１０３が存在する時点とは、輝点がｙ軸方向に距離δだけ移動することになる。

【００８１】

これは、例えば図１２に示すように、撮像素子１１５の結像面１１５’に結像した輝線２１０ｂの像は、高さのある物体１０３により、δだけｙ軸方向に移動することになる。ＦＧセンサ１０１と同様に、このδを計測することにより、物体１０３上の点１０３ａの位置が三次元的に特定できる。即ち、点１０３ａの高さがわかる。また、輝線２１０ｂの対応関係が不明にならない程度に、パターン２１０ａのピッチ、即ち輝線２１０ｂのピッチを細かくすれば、物体１０３の高さの分布はそれだけ詳細に計測できることになる。また、高さ演算部１１８による高さの算出は、図９の説明と同様である。

【００８２】

以上のように、ＦＧセンサ１０１’は、パターンを複数本の輝線とし、輝線の移動を計測することで、パターンを輝点とした場合に比べて、輝線の任意の点の移動を計測でき、輝線方向の連続的形状が認識できる。言い換えれば、図中Ｘ軸方向の計測の分解能を向上することができる。

【００８３】

図１３の模式的斜視図を参照して、ＦＧセンサ１０１’に適した輝線投影装置２１０について説明する。輝線投影装置２１０は、図１０で前述した光束発生部１０５と、ファイバーグレーティング２２０（以下、単にグレーティング２２０という）とを備えている。

【００８４】

ここでは、グレーティング２２０は、平面１０２に平行に（Ｚ軸に直角に）配置される場合で説明する。グレーティング２２０に、レーザ光Ｌ１を、Ｚ軸方向に入射させる。するとレーザ光Ｌ１は、個々の光ファイバーにより、そのレンズ効果を持つ面内で集光したのち、発散波となって広がって行き、干渉して、投影面である平面１０２にパターン２１０ａが投影される。なお、グレーティング２２０を平面１０２に平行に配置するとは、図１４で後述するように、例えば、グレーティング２２０を構成する第１ＦＧ素子２２２の各光ファイバー２２１の軸線を含む平面と、平面１０２とが平行になるように配置することである。

【００８５】

図１４の模式図を参照して、グレーティング２２０について説明する。（ａ）は斜視図、（ｂ）は正面図である。グレーティング２２０は、複数の光ファイバー２２１を各光ファイバー２２１の軸線を第１の方向ｖ１に向けて平行に且つ平面状に並べた第１のファイバーグレーティング素子２２２（以下第１ＦＧ素子２２２という）と、複数の光ファイバー２２１を各光ファイバー２２１の軸線を第１の方向ｖ１と異なる第２の方向ｖ２に向けて平行に且つ平面状に並べた第２のファイバーグレーティング素子２２３（以下第２ＦＧ素子２２３という）と、複数の光ファイバー２２１を各光ファイバー２２１の軸線を第１の方向ｖ１、第２の方向ｖ２と異なる第３の方向ｖ３に向けて平行に且つ平面状に並べた第

３のファイバーグレーティング素子２２４（以下第３ＦＧ素子２２４という）とを含んで構成される。本実施の形態では、各ＦＧ素子２２２、２２３、２２４の平面は、互いに平行である。ここでは、各ＦＧ素子を識別するために、第１ＦＧ素子、第２ＦＧ素子、第３ＦＧ素子と呼ぶ。本実施の形態では、第１ＦＧ素子、第２ＦＧ素子、第３ＦＧ素子の順序で重ね合わせてある。しかしながら他の順序、例えば、第１ＦＧ素子、第３ＦＧ素子、第２ＦＧ素子の順に重ね合わせてもよい。以下、各ＦＧ素子２２２、２２３、２２４の平面を素子平面という。

【００８６】
第１ＦＧ素子２２２、第２ＦＧ素子２２３、第３ＦＧ素子２２４は、前述したＦＧ素子１２２と同様なものである。また図示では、各ＦＧ素子２２２、２２３、２２４は、接触して配置している場合を示しているが、それぞれ、素子平面の法線方向に距離を空けて配置してもよい。この場合には、各ＦＧ素子２２２、２２３、２２４の互いの距離は、パターン２１０ａの投影に差支えない程度とする。

【００８７】
第１ＦＧ素子２２２と第２ＦＧ素子２２３と第３ＦＧ素子２２４は、重ね合わせてグレーティング２２０を構成する。なお、ここでの重ね合わせは、各ＦＧ素子２２２、２２３、２２４の各素子平面がほぼ平行になるように重ね合わされている。言い換えれば、本実施の形態では、グレーティング２２０は、第１ＦＧ素子２２２、第２ＦＧ素子２２３、第３ＦＧ素子２２４の順に、各々の素子平面が平行になるように重ね合わされている。また、グレーティング２２０は、光束発生部１０５により発生されるレーザ光束Ｌ１を透過させるように構成されている。ここでは、レーザ光束Ｌ１は、第１ＦＧ素子２２２、第２ＦＧ素子２２３、第３ＦＧ素子２２４の順に透過させる。レーザ光束Ｌ１は、典型的には、グレーティング２２０（第１ＦＧ素子２２２）の素子平面に対して垂直に入射させる。

【００８８】
さらに、図１４（ｂ）に示すように、本実施の形態では、第１の方向ｖ１と第２の方向ｖ２がほぼ直交している。また、第３ＦＧ素子２２４は、第３の方向ｖ３が、第１の方向ｖ１から所定の角度θだけ素子平面と平行な面内で回転させて重ね合わされている。所定の角度θについては、図１５を参照して後述する。

【００８９】
ここで、図１５を参照して、所定の角度θについて説明する。まず所定の角度θを与えることによる、輝点の変化について説明する。（ａ）では、（ｂ）に示すように、所定の角度θがθ１の場合で説明する。なお（ａ）は、（ｂ）の図中奥側から手前にレーザ光束Ｌ１を透過させた場合に投影されるパターン２１０ａ’の一部を示した図である。図示では、参考として、θ１は、１０°程度で示してある。まず、所定の角度θが０°であったときに投影されるパターン２１０ａ’の一部である輝点２５１、２５２、２５３、２５４、２５５に注目する。そして、第３ＦＧ素子２２４に所定の角度θ１を与えると、上記各輝点は、各輝点の生成方向である直線２５１ａに対して、それぞれ角度θ１をなす直線２５１ａ’方向に回折して新たな輝点を投影する。さらに説明するならば、輝点２５１に注目すると、輝点２５１は、直線２５１ａ’方向に、回折して新たな輝点２５１’を投影する。

【００９０】
これにより、所定の角度θによって輝点の回折方向が変わるので、θによっては、例えば平行であり、等間隔に配列された複数の輝線列（以下単に複数の輝線という）や、密な輝点アレイを投影することができる。言い換えれば、第３ＦＧ素子２２４に所定の角度θを調整することで、複数の輝線を容易に投影することができる。

【００９１】
図１６の模式図を参照して、所定の角度θを調整して、パターンを複数の輝線とする場合の例について説明する。輝線は、複数の輝点が直線的に集合することで形成される。また、ＦＧ素子は、低次から高次の回折光に渡って回折効率が一定に近く、また輝線は、複数の輝点が集合することで形成されているので、輝線の中央部の明るさが、中央部から輝線

の端部方向にいっても変化しにくい。即ち、輝度が均一な輝線を投影できる。複数の輝線にする場合には、所定の角度θは、０．１～１０°、好ましくは１～８°、最も好ましくは５°程度とするとよい。また、θ＝８５°の場合にも、同様な複数の輝線となる。但し、この場合には、投影されるパターンは、（ｂ）を９０°回転させたパターンとなる。

【００９２】

以上のように、輝線投影装置２１０は、レーザ光束Ｌ１を第１ＦＧ素子２２２と、第２ＦＧ素子２２３と、第３ＦＧ素子２２４を透過させることで、複数の輝線のパターン２１０ａを投影できるので、単純に構成できる。また、輝線投影装置２１０は、重ね合わせた第１ＦＧ素子２２２と、第２ＦＧ素子２２３と、第３ＦＧ素子２２４とを含んで構成されたグレーティング２２０が光学系となるので、複雑な光学系を必要とすることなく、光学筐体を小型化できる。さらに、このように構成されているので、複数の輝線をパターン２１０ａとして平面１０２に投影できる。さらに、輝線を、輝点の集合により形成するので、輝度が均一な複数の輝線を投影できる。このため、本実施の形態のように輝線の移動を測定する場合に優位性がある。

【００９３】

なお、輝線投影装置は、上述した輝線投影装置２１０の場合で説明したがこれに限られない、例えばシリンドリカルレンズや、スリット等を用いて、パターン２１０ａとして複数の輝線を投影するように構成してもよい。

【００９４】

図１７に、輝線投影装置の別の例として、輝線投影装置３１０を示す。輝線投影装置３１０は、光学ガラスで形成された光学素子３１１を有している。また光学素子３１１は、光束の入射側に断面が略三角形の凸３１１ａ部が形成され、さらに凸部３１１ａの光束の入射側先端部には、円筒面３１１ｂが形成される。光学素子３１１は、典型的にはＵＳ４８２６２９９に開示されているパウエルレンズである。このような光学素子３１１の円筒面３１１ｂに、光束発生部１０５’により、この円筒面３１１ｂの曲率半径より小さい径のレーザ光束Ｌ１’を入射させることで、対象領域に輝線を投影できる。さらに、光学素子３１１の対象領域側に、回折素子、例えば前述したＦＧ素子を配置することで、複数の輝線を投影することができる。輝線投影装置３１０は、このような光学素子３１１を用いることで、輝度が均一な複数の輝線を投影することができる。

【００９５】

また、図１８の模式図に示すように、ＦＧセンサ１０１’は、対象領域を、輝線を対象物の動きに比べて十分に高速で、図中ｙ軸方向に走査し、輝線が対象領域の異なる位置に投影されたパターン像を複数撮像するようにしてもよい。この場合には、輝線発生手段を、投影した輝線を対象領域の特定方向に走査できる輝線投影装置２１０’とする。また、この場合には、このように撮像された複数のパターン像の組み合わせにより、前述のパターン２１０ａ（図１１参照）の像であるパターン像としてもよい。言い換えれば、（ｂ）に示すように、異なる位置に投影された輝線のパターン像を組合わせることで、前述の複数の輝線即ちパターン２１０ａが投影された対象領域のパターン像と同じパターン像を生成してもよい。さらに説明すれば、例えば図示のように、時間ｔ１、ｔ２、ｔ３、ｔ４に取得したパターン像を組合わせて、複数の輝線が投影された対象領域のパターン像を生成することである。即ち、対象領域内を輝線が走査している間に、パターン像を取得した回数が、組み合わされたパターン像上の輝線の像の本数となる。なお、走査する輝線は、典型的には１本である。

【００９６】

ここで、図１９の模式的外観図を参照して、室内監視装置１の場合のＦＧセンサ１０１の設置例について説明する。輝点投影装置１１０と、撮像装置１１１は、浴室３の壁面６４の上部両端に配置されている。図示では、人物２のおよそ頭部上方側の端部に輝点投影装置１１０が、輝点投影装置１１０の配置された端部と逆側の端部に撮像装置１１１が配置されている。（ｂ）に示すように、輝点投影装置１１０は、浴室３の浴槽４上と洗い場７上とにパターン１１０ａを投影している。また、撮像装置１１１の画角は、浴室３全体を

撮像できるように設定されいる。また制御装置１１４は、図２で説明した制御部２１内に組み込んでもよい。このようにすることで、室内監視装置１の構成を単純化できる。

【００９７】

また、輝点投影装置１１０は、典型的には、その光軸（レーザ光束の投射方向）を、図示のように対象領域の垂直方向に対して傾けて設置する。このようにすることで、容易に広範囲にパターン１１０ａを投影できる。また、例えば撮像装置１１１と輝点投影装置１１０との距離を離して設置することが容易に行なえる。言い換えれば、基線長を長く取ることが容易に行なえる。また、撮像装置１１１も同様に、対象領域の垂直方向に対し、光軸を傾けて設置する。このようにすることで、容易に浴室３全体を撮像することができる。また、基線長を長く取ることが容易に行なえる。なおここでは、上記のように、輝点投影装置１１０、撮像装置１１１は、それぞれの光軸を水平面の垂直方向に対して傾けて設置するが、前記垂直方向に対して、およそ平行方向に設置してもよい。また、それぞれの光軸を、互いに平行方向に向けて設置してもよい。

【００９８】

また、撮像装置１１１と輝点投影装置１１０とは、ある程度距離を離して設置するとよい。このようにすることで、図７で前述した距離ｄ（基線長ｄ）が長くなるので、変化を敏感に検出できるようになる。ここでは、壁面６４の上部両端に配置することで、基線長を長く取っている。なお、基線長は長く取ることが好ましいが、短くてもよい。但しこの場合には、呼吸等の小さな動きを検出しにくくなるが、前述のように、人物２の重心位置を検出するようにすれば、小さな動き（呼吸）の検出も可能である。なお、ここでは、ＦＧセンサ１０１ついて説明したが、ＦＧセンサ１０１’についても同様に設置してよい。

【００９９】

以上のような、ＦＧセンサ１０１を３次元センサ１０として用いることで、対象領域内の３次元情報を正確に取得できる。また、３次元センサ１０は、上述したＦＧセンサ１０１に限らず、対象領域の３次元情報を取得できるものなら何でもよく、例えば、モアレを用いたセンサ、ステレオカメラを用いたセンサ、複数の距離センサを用いたセンサであってもよい。

【０１００】

モアレを用いたセンサは、例えば、２つのスリットを用いて形成したモアレ縞を撮像することにより、３次元情報を取得できる。モアレを用いることで、縞方向の高さ分布を連続的に測定できるので、高精度な３次元情報を取得できる。モアレとは、２つの規則的な強度分布を重ねたとき、両者の空間周波数の差によって生じる粗い縞模様である。２つの強度分布の和によって生じる和のモアレと、積によって生じる積のモアレとがあり、前者は２つの規則的分布を二重露光した写真で実現でき、後者はそれぞれの規則的分布を記録した透明画を重ねて見ればよい。また、モアレ縞の位相の情報を利用することで、高精度に人物２の動きを検出することもできる。

【０１０１】

また、ステレオカメラを用いたセンサは、例えば２つのＣＣＤカメラにより、ステレオ画像を取得し、このステレオ画像上の対応点を探索することで、対象領域の高さ分布を三角法により測定できる。即ち、対象領域の３次元情報を取得できる。二次元画像に基づいて、３次元情報を取得するので高精度である。

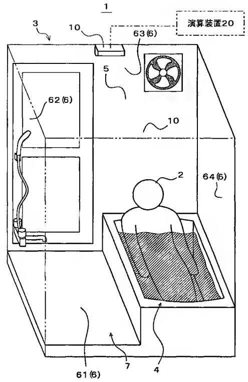
【０１０２】

さらに、複数の距離センサを用いたセンサは、必要な測定点に対応して複数の距離センサを設置、対象領域の複数の測定点の距離を測定することで、３次元情報を取得することができる。距離センサを用いることで、外乱光の影響が少なく正確に３次元情報を取得できる。また、画像処理の必要がないので、単純な構成とすることができる。使用する距離センサは、基本的には何でもよく、例えば、赤外線センサのような三角法を用いたタイプであってもよいし、超音波センサであってもよく、タイムツウフライト（Ｔｉｍｅ―ｔｏ―ｆｌｉｇｈｔ）のタイプ（光が出射して帰ってくる時間を測定し、距離を測定するもの）であってもよい。

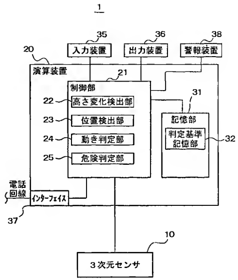
【０１０３】
【発明の効果】
以上のように、本発明によれば、対象領域内の３次元情報を取得する３次元センサと、前記取得した３次元情報に基づいて、前記対象領域内の高さの変化を検出する高さ変化検出手段と、前記検出された高さの変化に基づいて、対象物の位置を検出する位置検出手段と、前記検出された高さの変化に基づいて、前記対象物の動きを検出する動き検出手段と、前記検出された対象物の位置と動きに基づいて、前記対象物が危険な状態にあるか否かを判定する危険判定手段とを備え、前記危険判定手段は、前記危険な状態にあるか否かの判定を、前記対象領域内の位置毎に設定された判定基準に基いて行なうように構成されるので、対象物の危険な状態を正確に判定するだけでなく、単純な空間内監視装置を提供できる。
【図面の簡単な説明】
【図１】本発明の第１の実施の形態である室内監視装置の模式的外観図である。
【図２】本発明の第１の実施の形態である室内監視装置の構成を示すブロック図である。
【図３】本発明の第１の実施の形態で用いる、呼吸の波形パターンについて示した概要図である。
【図４】図３の場合での、正常及び異常な呼吸の波形パターンについて示した概要図である。
【図５】図４の場合の、異常な呼吸の波形パターンに対応する病名または疾患箇所の表を示した図である。
【図６】本発明の第２の実施の形態である室内監視装置の模式的外観図である。
【図７】本発明の実施の形態であるＦＧセンサの概念的斜視図である。
【図８】図７の場合での結像面に結像したパターンの像を説明する模式図である。
【図９】図７の場合での対象物の高さの演算について説明する線図である。
【図１０】図７の場合での輝点投影装置を説明する模式的斜視図である。
【図１１】本発明の実施の形態である光切断法を用いたＦＧセンサの概念的斜視図である。
【図１２】図１１の場合のパターンの像を説明する線図である。
【図１３】図１１の場合での輝線投影装置を説明する模式的斜視図である。
【図１４】図１３の場合でのグレーティングについて説明する、（ａ）斜視図、（ｂ）正面図である。
【図１５】図１４のグレーティングにより投影されるパターンについて説明する、（ａ）パターンの模式図、（ｂ）グレーティングの正面図である。
【図１６】図１４のグレーティングにより投影されるパターンを示す模式的平面図である。
【図１７】図１１の場合での輝線投影装置の別の形態を示す模式的斜視図である。
【図１８】図１１の場合での輝線投影装置のさらに別の形態を示す図であり、（ａ）ＦＧセンサの模式的斜視図、（ｂ）パターン像の組み合わせについて説明ずる模式図である。
【図１９】本発明の実施の形態であるＦＧセンサを浴室に設置する場合の例を説明する、（ａ）模式的外観図、（ｂ）平面図である。
【符号の説明】
1　室内監視装置
2　人物
3　浴室
4　浴槽
7　洗い場
１０　３次元センサ
２０　演算装置
２１　制御部
２２　高さ変化検出部

２３　位置検出部
２４　動き検出部
２５　危険判定部
３１　記憶部
３８　警報装置
１０１　ＦＧセンサ
１０１’　ＦＧセンサ（光切断法を用いたもの）
１０２　平面
１０３　物体
１０５　光束発生部
１１０　輝点投影装置
１１０ａ　パターン
１１０ｂ　輝点
１１１　撮像装置
１１４　制御装置
１１５　撮像素子
１１７　画像処理装置
１１８　高さ演算部
１２０　グレーティング
１２１　光ファイバー
１２２　ＦＧ素子
２０１　室内監視装置
２０３　トイレ
２０４　便器
２１０　輝線投影装置
２１０ａ　パターン
２１０ｂ　輝線
２２０　グレーティング
２２１　光ファイバー
２２２　第１ＦＧ素子
２２３　第２ＦＧ素子
２２４　第３ＦＧ素子

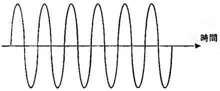
【図１】


1
3
10
演算装置20
63(6)
5
62(6)
10
2
64(6)
61(6)
7
4

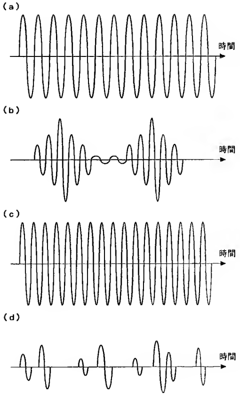
【図２】


1
35
36
38
入力装置
出力装置
警報装置
20
演算装置
21
制御部
31
22
高さ変化検出部
23
位置検出部
記憶部
24
動き判定部
判定基準記憶部
32
25
危険判定部
電話回線
インターフェイス
37
10
3次元センサ

【図３】


時間

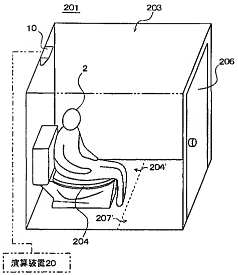
【図４】


(a)
時間
(b)
時間
(c)
時間
(d)
時間

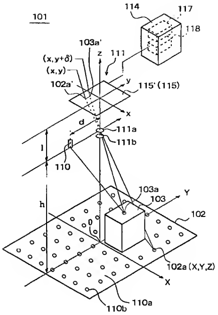
【図５】

Cheyne－Stokes 呼吸	両側大脳皮質下および間脳の障害
中枢性過換気	中脳下部から橋上部の障害
失調性呼吸	橋下部から延髄上部の障害
Kussmaul の大呼吸	糖尿病性昏睡または尿毒症

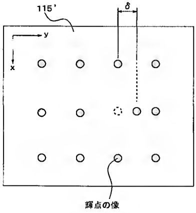
【図６】



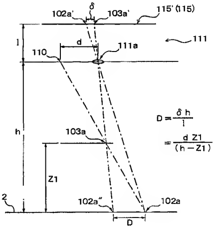
【図７】



【図８】

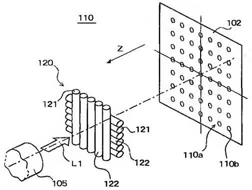


【図９】

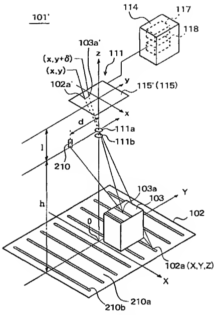


$$D = \frac{\delta h}{l} = \frac{d\ Z1}{(h - Z1)}$$

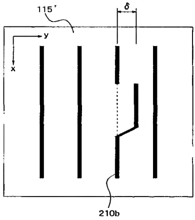
【図１０】



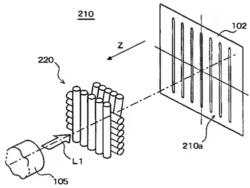
【図１１】



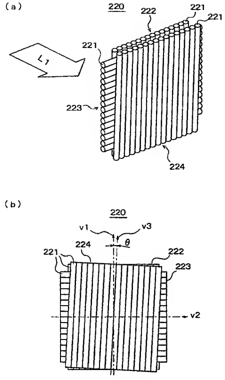
【図１２】



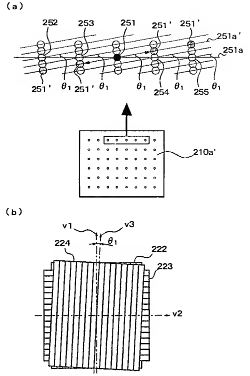
【図１３】



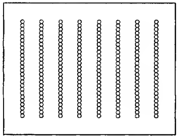
【図14】



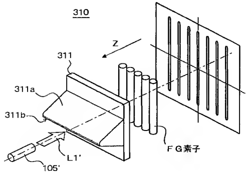
【図15】



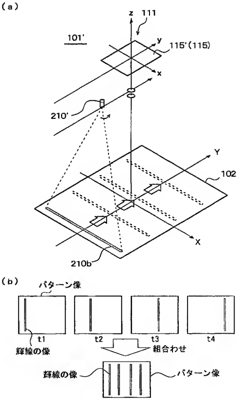
【図16】



【図17】

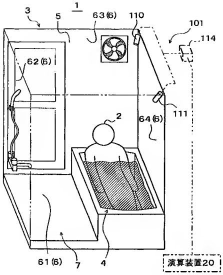


【図18】

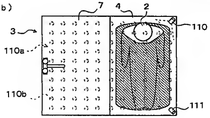


【図１９】

(a)


3
1
5
63(6)
110
101
114
62(6)
111
2
64(6)
61(6)
7
4
演算装置20

(b)


7
4
2
3
110
110a
110b
111

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(56)参考文献 特開２００２－１７５５８２（ＪＰ，Ａ）
特開２００１－２８３２２５（ＪＰ，Ａ）
特開２００１－１０１５４７（ＪＰ，Ａ）

(58)調査した分野(Int.Cl.，ＤＢ名)
A61B 5/11

CLAIMS

(57)[Claim(s)]
[Claim 1]
One three-dimensional sensor which acquires three-dimensional information in an object domain;
A height change detecting means which detects change of height in said object domain based on said acquired three-dimensional information;
A position detecting means which detects a position of a subject which carries out breathing, a body motion, and movement based on change of said detected height;
A motion detecting means which detects movement toward breathing of said subject, a body motion, and movement based on change of said detected height;
Said subject is provided with a risk decision means to judge whether it is in a dangerous state, based on a position of said detected subject, and a motion.;
Said risk decision means is constituted so that a judgment of whether to be in said dangerous state may be performed based on a judging standard set up for every position in said object domain.;
The 1st field judge that is in said dangerous state by said risk decision means when a motion with large amplitude based on a body motion of said subject and movement in said object domain is no longer detected, When [at which a motion with small amplitude based on breathing of said subject was confused] detected no longer at the time. Or when the state where a motion with small amplitude based on breathing of said subject is not detected carries out predetermined time continuation, or when a body motion of said subject occurs frequently for a short time, it has the 2nd different field from said 1st field judge that is in said dangerous state by said risk decision means.;
It judges with said judging standard being in said dangerous state, when a motion whose amplitude based on a body motion of said subject and movement is large when it detects that said subject is in said 1st field by said position detecting means is no longer detected, When it detects that said subject is in said 2nd field by said position detecting means. When [at which a motion with small amplitude based on breathing of a ****** subject was confused] detected no longer at the time. Or it was constituted so that it might judge with it being in said dangerous state, when the state where a motion with small amplitude based on breathing of said subject is not detected carries out predetermined time continuation, or when a body motion of said subject occurred frequently for a short time.;
A monitoring instrument in space.
[Claim 2]
Detection of said breathing by said motion detecting means set a threshold of a predetermined maximum minimum as both or either of amplitude and cycles of a periodic change of change of said height which was detected by said height change detecting means, judged whether it was breathing as compared with this threshold, and it was constituted so that breathing might be detected.;
A monitoring instrument in the space according to claim 1.
[Claim 3]

When a motion of said subject was no longer detected after being a time of detecting that said judging standard has said subject in said 1st field by said position detecting means and detecting movement of said subject near the entrance of said 1st field, it was constituted so that it might not judge with a dangerous state.;
A monitoring instrument in the space according to claim 1 or 2.
[Claim 4]
Said object domain is a bathroom.;
Said 1st field is a washing place.;
Said 2nd field is an organ bath.;
A monitoring instrument in space given in any 1 paragraph of claim 1 thru/or claim 3.
[Claim 5]
Said object domain is a toilet.;
Said 1st field is a position near the entrance.;
Said 2nd field is a position near the toilet bowl.;
A monitoring instrument in space given in any 1 paragraph of claim 1 thru/or claim 3.
[Claim 6]
A projection means to which said three-dimensional sensor projects a luminescent line or two or more luminescent spots on said object domain;
An imaging means which picturizes a pattern formed by said projection;
It has height operation part which calculates height of said subject by trigonometry based on said picturized pattern image and a reference image.;
A monitoring instrument in space given in any 1 paragraph of claim 1 thru/or claim 5.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the monitoring instrument in space for supervising change of the position of a subject, a motion, etc. which exists especially in space about the monitoring instrument in space which supervises a subject.
[0002]
[Description of the Prior Art]
The motion detection sensor is proposed from the former as a monitoring instrument which supervises change of a motion of the subject in the inside of space, for example, a bathroom, a toilet, etc., for example, a person. A typical example is a thing which divides into two or more part images the picture which picturized and acquired the picture in a bathroom, detects whether there is any motion of a subject from change of a luminosity and a color for every part image, and judges whether the person under bathing is moving by the situation of a motion of each part image. In the object for the interior of a room, the device which judges an indoor person's condition from a mutual output as a device which detects the condition of the person in a single room including a fall combining the infrared image sensor attached to the ceiling and the heat ray height sensor which attaches to a wall surface and makes fixed height detection area is proposed. This device can detect whether the person under staying in the room has taken the low posture, or the high posture is taken, it is in tipping condition, or that is not right by setting up the detection height area of the sensor of a wall surface suitably.
[0003]
There was a monitoring instrument which supervises a sleeping person's breathing by computing the movement magnitude of a pattern from the picture which projected the pattern on the sleeping person on a bed, and picturized the projected pattern continuously (for example, refer to patent documents 1.).
[0004]
[Patent documents 1]
JP,2002-175582,A (the five - 9th page, Drawing 13 [one to])
[0005]
[Problem(s) to be Solved by the Invention]
However, according to the above conventional devices, when the motion of a person had stopped, for example, it fell whether it was in the state which merely keeps still, and it was not able to be judged whether it was in a dangerous state.
[0006]
Then, it not only judges the dangerous state of a subject correctly, but an object of this invention is to provide the simple monitoring instrument in space.

[0007]
[Means for Solving the Problem]
To achieve the above objects, the monitoring instrument 1 in space by invention concerning claim 1, For example, the one three-dimensional sensor 10 which acquires three-dimensional information in the object domain 3 as shown in drawing 1 and drawing 2; based on said acquired three-dimensional information, The height change detecting means 22 which detects change of height in the object domain 3; based on change of said detected height, The position detecting means 23 which detects a position of the subject 2 which carries out breathing, a body motion, and movement; based on change of said detected height, The motion detecting means 24 which detects movement toward breathing of the subject 2, a body motion, and movement; based on a position of said detected subject 2, and a motion, The subject 2 is provided with a risk decision means 25 to judge whether it is in a dangerous state, and it; risk decision means 25, It is constituted and so that a judgment of whether to be in said dangerous state may be performed based on a judging standard set up for every position in the object domain 3 the; object domain 3, The 1st field 7 judge that is in said dangerous state by the risk decision means 25 when a motion with large amplitude based on a body motion of the subject 2 and movement is no longer detected, When [at which a motion with small amplitude based on breathing of the subject 2 was confused] detected no longer at the time. Or have the 2nd field 4 that differs in the 1st field 7 judge that is in said dangerous state by the risk decision means 25 when the state where a motion with small amplitude based on breathing of the subject 2 is not detected carries out predetermined time continuation, or when a body motion of the subject 2 occurs frequently for a short time, and the; aforementioned judging standard, It judges with it being in said dangerous state, when a motion whose amplitude based on a body motion of the subject 2 and movement is large when it detects that the subject 2 is in the 1st field 7 by the position detecting means 23 is no longer detected, When it detects that the subject 2 is in the 2nd field 4 by the position detecting means 23. When [at which a motion with small amplitude based on breathing of ******** 2 was confused] detected no longer at the time. Or it is constituted so that it may judge with it being in said dangerous state, when the state where a motion with small amplitude based on breathing of the subject 2 is not detected carries out predetermined time continuation, or when a body motion of the subject 2 occurs frequently for a short time.
[0008]
Since it has the three-dimensional sensor 10, the height change detecting means 22, the position detecting means 23, and the motion detecting means 24 if constituted in this way, a position of the subject 2 and a motion are detectable. Have the risk decision means 25 and the risk decision means 25, Since it is constituted so that a judgment of whether to be in said dangerous state may be performed based on a judging standard set up for every position in the object domain 3, it not only can judge a dangerous state of a subject correctly, but it can provide a simple monitoring instrument in space.
[0009]
As mentioned above, the subject 2 carries out breathing, a body motion, and movement, and the; motion detecting means 24 comprises the monitoring instrument 1 in the space according to claim 1 so that breathing of the subject 2, a body motion, and movement may be detected. In this case, although the subject 2 which carries out breathing, a body motion, and movement is a person, for example, it may be an animal.
[0010]
If constituted in this way, since breathing of the subject 2 is detected, even when there is almost no motion of a subject, the motion detecting means 24 is detecting breathing, and can judge the safety, for example. That is, a dangerous state of a subject can be judged. Since a dangerous state of the subject 2 can also be judged by judging normality of the breathing, and abnormalities also from detected breathing, the reliability of a judgment of a dangerous state increases.
[0011]

As mentioned above, in the monitoring instrument 1 in the space according to claim 1, the motion detecting means 24 can detect movement of the subject 2.
To claim 2, like a statement in the monitoring instrument 1 in the space according to claim 1. It is good for detection of said breathing by the motion detecting means 24 to constitute so that a threshold of a predetermined maximum minimum may be set as both or either of amplitude and cycles of a periodic change of change of said height which was detected by the height change detecting means 22, it may judge whether it is breathing as compared with this threshold and breathing may be detected.
To claim 3, like a statement in the monitoring instrument 1 in the space according to claim 1 or 2.Said judging standard is a time of detecting that the subject 2 is in the 1st field 7 by the position detecting means 23, and when a motion of the subject 2 is no longer detected after movement of the subject 2 is detected near the entrance of the 1st field 7, it is good to constitute so that it may not judge with a dangerous state.
Like a statement to claim 4, as the monitoring instrument 1 in space given in any 1 paragraph of claim 1 thru/or claim 3 shows, for example to drawing 1, it is good in said object domain being the bathroom 3, the 1st field of; above being the washing place 7, and the 2nd field of; above being the organ bath 4.
To claim 5, like a statement in the monitoring instrument 1 in space of a statement, in any 1 paragraph of claim 1 thru/or claim 3. For example, as shown in drawing 6, it is good in said object domain being the toilet 203, the 1st field of; above being position 207' near the entrance, and the 2nd field of; above being position 204' near the toilet bowl.
[0012]
In the monitoring instrument 1 in space of a statement, in any 1 paragraph of claim 1 thru/or claim 5.The position detecting means 23 judges an existence region where the subject 2 exists based on said detected height change, It is a field including said judged existence region, and it is good to constitute so that a field where only a predetermined range expanded said existence region may be computed, priority may be given to said expanded field and a position of the subject 2 may be detected.
[0013]
Since a position of the object 2 will be detected from a field where a possibility that the subject 2 exists is high, for example if constituted in this way, time which detection of a position of the subject 2 takes can be shortened, and improvement in the speed of processing can be attained.
[0014]
To claim 6, like a statement in the monitoring instrument 1 in space of a statement, in any 1 paragraph of claim 1 thru/or claim 5. As shown in drawing 7 and drawing 11, the three-dimensional sensor 101 to said object domain For example, a luminescent line. Or the projection means 110 and 210 which project two or more luminescent spots and the imaging means 111 which picturizes a pattern formed by the; aforementioned projection; it has the height operation part 118 which calculates height of said subject by trigonometry based on said picturized pattern image and a reference image.
[0015]
A luminescent line with which the three-dimensional sensor 101 was projected on said object domain by the projection means 110 and 210 when constituted in this way. Or a pattern formed of two or more luminescent spots is picturized by the imaging means 111, and by the height operation part 118, since height of said subject is calculated by trigonometry based on said picturized pattern image and a reference image, though it is simple, height of a subject can be measured correctly. When a pattern is made into a luminescent line, continuous height of the direction of a luminescent line can be measured, for example.
[0016]
[Embodiment of the Invention]

Hereafter, an embodiment of the invention is described with reference to drawings. Identical codes are given to the member which is mutually the same or corresponds in each figure, and the duplicate explanation is omitted.
[0017]
Drawing 1 is a typical outline view of the indoor monitoring instrument 1 as a monitoring instrument in space which is a 1st embodiment by this invention. The indoor monitoring instrument 1 is installed in a bathroom. The indoor monitoring instrument 1 is constituted including the three-dimensional sensor 10 which acquires the three-dimensional information in an object domain, and the arithmetic unit 20. The indoor monitoring instrument 1 is constituted so that an object domain may be supervised. A subject breathes. That is, subjects are a person and an animal, for example. In this embodiment, a subject is the person 2. In this embodiment, an object domain is the bathroom 3. The three-dimensional sensor 10 has two or more point of measurement in the object domain, and can measure the height in each point of measurement. In this embodiment, three-dimensional information is coordinates of two or more point of measurement in the bathroom 3, and the height measured on each point. In other words, three-dimensional information is the level distribution in the bathroom 3.
[0018]
The bathroom 3 is the closed space surrounded by the wall surface 6 in the four quarters, and the ceiling 5 is formed up. The wall surface 6 comprises the front wall side 61, the left lateral wall surface 62, the back wall side 63, and the right lateral wall surface 64 (when only calling it below the wall surfaces 61, 62, 63, and 64 and not distinguishing, it is only called the wall surface 6). Furthermore, the bathroom 3 is provided with the following.
Organ bath 4.
Washing place 7.
And the organ bath 4 adjoins the washing place 7, and is installed.
[0019]
The three-dimensional sensor 10 is arranged in the upper part of the bathroom 3. The upper part of the bathroom 3 is the upper part of the ceiling 5 or the wall surface 6 typically. The graphic display shows the case where it arranges to the corner which the ceiling 5 and the wall surface 6 form. The three-dimensional sensor 10 is explained in full detail later. The three-dimensional sensor 10 and the arithmetic unit 20 are electrically connected. Although it is indicated as the three-dimensional sensor 10 and the arithmetic unit 20 as a different body, it may constitute from a graphic display in one. If it does in this way, the indoor monitoring instrument 1 can be miniaturized.
[0020]
With reference to the block diagram of drawing 2, the example of composition of the indoor monitoring instrument 1 is explained. It is connected to the arithmetic unit 20, and the three-dimensional sensor 10 is constituted so that the acquired three-dimensional information may be outputted to the arithmetic unit 20. The arithmetic unit 20 is good to constitute so that three-dimensional information may be serially acquired from the three-dimensional sensor 10. The arithmetic units 20 are computers, such as a personal computer and a microcomputer, for example. The arithmetic unit 20 has the control section 21 which controls the indoor monitoring instrument 1.

[0021]
The storage parts store 31 is connected to the control section 21. The storage parts store 31 is good to memorize the three-dimensional information acquired more nearly serially than the three-dimensional sensor 10. To the storage parts store 31, the data of the information etc. which were computed is memorizable. The storage parts store 31 has the judging standard storage parts store 32 the judging standard set up for every position in the bathroom 3 mentioned later is remembered to be.
[0022]

The output unit 36 which outputs the result processed with the input device 35 which inputs the information for operating the indoor monitoring instrument 1, and the indoor monitoring instrument 1 is connected to the control section 21. The input device 35 is a touch panel, a keyboard, or a mouse, and the output units 36 are a display and a printer. It may be built although the input device 35 and the output unit 36 are illustrated in this figure as what carries out external to the arithmetic unit 20. The input device 35 of the switch and the output unit 36 which can perform the start and release of surveillance (risk decision) in an object domain, for example is good also as LED as an operation indicator, for example. If it does in this way, the indoor monitoring instrument 1 can be constituted simply. When it constitutes the three-dimensional sensor 10 and the arithmetic unit 20 in one especially, constituting in this way is preferred. By doing in this way, it can be considered as a simpler and small indoor monitoring instrument.

[0023]

The height change primary detecting element 22 as a height change detecting means which detects change of the height in the bathroom 3 in the control section 21 based on the three-dimensional information acquired from the three-dimensional sensor 10, The position detector 23 as a position detecting means which detects the person's 2 position based on change of the height detected by the height change primary detecting element 22, The motion detection part 24 as a motion detecting means which detects a motion of the person 2 based on change of the height detected by the height change primary detecting element 22, Based on the person's 2 position and motion which were detected, it has the risk decision part 25 as a risk decision means by which the person 2 judges whether it is in a dangerous state. The position of the person 2 who detects by the position detector 23 is a position of the field where the person 2 exists, for example, and the position of the person's 2 existence region is a centroid position of the person's 2 existence region typically. Detecting a motion of the person 2 is a concept including detecting that the person 2 does not have a motion. Motions here are breathing, a body motion, and movement, for example. A body motion is a motion of the person's 2 body, for example, is a concept which includes widely a motion of hand and foot besides the motion of standing or sitting down. Hereafter, each composition is explained.

[0024]

Detection of change of the height by the height change primary detecting element 22 detects change of the height in each point of measurement in the bathroom 3 by computing the difference of the three-dimensional information acquired from the three-dimensional sensor 10, and the three-dimensional information saved serially at the storage parts store 31. In other words, change of the height in each point of measurement in the bathroom 3 is detected by taking the difference of the acquired newest three-dimensional information and the three-dimensional information acquired in the past. The three-dimensional information acquired in the past is three-dimensional information typically acquired from the newest three-dimensional information before one (past). Three-dimensional information is acquired from the three-dimensional sensor 10 with a certain time interval in this case. The acquisition interval of three-dimensional information is good to consider it as about 0.1 to 0.5 second preferably about 0.1 to 3 seconds, for example. Since the influence of random noise can be reduced, for example by acquiring three-dimensional information in shorter time, and performing processing of equalization or filtering, it is effective. An acquisition interval is good also as comparatively long about time, for example, 5 to 20 seconds. In this case, it becomes easy to detect the person's 2 big body motion, for example.

[0025]

The three-dimensional information or height change acquired from the three-dimensional sensor 10 is good also as the moving average deviation of the value which carried out past fixed count acquisition, or was acquired within past fixed time, or period average rates. By doing in this way, the sudden noise by flicker of the daylight inserted from random noise or a window, etc. can be reduced, and incorrect judgment of the erroneous decision of a peak position and a zero cross position (intersection which numerals reverse) can be reduced.

[0026]
The position detector 23 is good to constitute so that the existence region where the person 2 exists may be judged based on height change detected by the height change primary detecting element 22 and the centroid position of said judged existence region may be made into the person's 2 position. By doing in this way, since the person's 2 position is detectable at not a field with area but a point, a slight motion of the person 2 can be detected comparatively sensitively.
[0027]
The judgment of an existence region is a point which is in the predetermined range from this attention point, for example paying attention to height change of the arbitrary point of measurement if height change is beyond a threshold, Height change is beyond a threshold, the number of the point of measurement as a focused position where the direction of change is the same is calculated, and if that number is more than a predetermined value, it will be considered that this range is an existence region.
[0028]
The position detector 23 is a field including the judged existence region, may compute the field where only the predetermined range expanded the existence region, may give priority to the expanded field, and it may constitute it so that the person's 2 position may be detected. In this embodiment, the acquisition interval of the three-dimensional information by the three-dimensional sensor 10, Since it is enough set up for a short time as compared with the motion of the person 2, also when the person 2 does not move greatly between this acquisition interval and then the person's 2 position is detected, the person 2 is considered to exist in the almost same field that position [the field] or adjoined. For this reason, the method of giving priority to the field where only the predetermined range expanded the existence region, and detecting the person's 2 position is effective. By doing in this way, since a possibility that the person 2 exists gives priority to a high field and the person's 2 position is detected, the person's 2 searching time can be shortened and improvement in the speed of processing can be attained.
[0029]
The motion detection part 24 detects a motion of the person 2 based on change of the height detected by the height change primary detecting element 22, as mentioned above. Based on change of the height detected by the height change primary detecting element 22, the motion detection part 24 is constituted so that the person's 2 breathing may be detected.
[0030]
Detection of breathing by the motion detection part 24 sets the threshold of a predetermined maximum minimum to [which was detected by the height change primary detecting element 22 / both or either one of] the amplitude of the periodic change of height change or a cycle (frequency), judges whether it is breathing as compared with this threshold, and detects breathing. The threshold of the maximum minimum of a cycle is good to set the range which contains the cycle of breathing of a person, for example, for example, a minimum, as per minute 5 cycles, and to set a maximum as per minute 60 cycles. By the way, although a grown-up breathing rate is in about per minute 5 to 30 times of ranges, in the case of a small child, there is a tendency for a breathing rate to increase further. The threshold of the maximum minimum of amplitude is good similarly to set it as the value which is equivalent to 1 mm in the range which contains the amplitude of breathing of a person, for example, for example, a minimum, and is equivalent to height change of about 20 mm in a maximum. Thereby, the person's 2 detected breathing forms a waveform pattern.
Drawing 3 is a figure showing the example of the waveform pattern of breathing.
[0031]
the motion detection part 24 is big to the person 2, if detected height change is beyond a predetermined value -- it moved, namely, the body motion occurred -- it is good to constitute so that it may judge. A predetermined value is preferably set as not less than 20 mm not less than 10 mm, for example. It is made to set up not lap with the range of the below-mentioned breathing. It

may be made to judge with there having been a motion which is different whenever it carries out multidata input of the predetermined value and exceeds a constant value everywhere which was set up. By doing in this way, even if it is a body motion, a small body motion and a big body motion of standing or sitting down to which an arm is moved can be distinguished and judged, for example. That is, a motion of the person 2 can be judged more finely. Since height change is far changed sharply compared with the case where only breathing is detected from height change, detection of the person's 2 body motion is easily detectable. Even when the person 2 does a periodic and small motion like a convulsion, it can be detected from a waveform pattern. In such a case, the person's 2 convulsion is also detectable by comparing with the pattern by saving the waveform pattern of the motion which is twitching further at the storage parts store 31.

[0032]

Based on the average value of the height change in the existence region judged by the position detector 23, the motion detection part 24 may be constituted so that a motion of the person 2 may be detected. If it does in this way, the reliability of detection of the motion by the motion detection part 24 will improve.

[0033]

The motion detection part 24 is constituted so that movement of the person 2 can be detected. Detection of movement shall include detection of the direction of movement, speed, and distance besides detection of the existence of movement. The movement can detect the existence of movement at least by, for example, detecting change of the person's 2 position detected by the position detector 23. For example, the person's 2 movement speed is easily detectable by acquiring the person's 2 position with a certain time interval.

[0034]

The risk decision part 25 judges whether the person 2 is in a dangerous state based on the motion of the person 2 detected by the position and the motion detection part 24 of the person 2 detected by the position detector 23. The risk decision part 25 is constituted so that the judgment of whether to be in a dangerous state may be performed based on the judging standard set up for every position in the bathroom 3. Here, the judging standard set up for every position in the bathroom 3 is set up for every position of the organ bath 4, and position of the washing place 7.

[0035]

The judging standard of a dangerous state is explained. The standard judge that is in a dangerous state, for example in the washing place 7. When the amplitude of a motion of the person 2 becomes small and a motion of the person 2 disappears from the state where the amplitude of a motion of the person 2 is large and where in other words body motions (for example, motion of a hand when washing the back etc.) are detected, suddenly, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is because the person 2 fell or can surmise that it fainted, for example. However, when a motion of the person 2 is lost after movement was detected near the entrance of the bathroom 3 even especially in the washing place 7, it is made not to judge with a dangerous state. This is because the person 2 can judge with having come out of the bathroom 3. When it is such a judging standard, when [with large amplitude of a motion of the person 2] in other words body motions (for example, motion of a hand when washing the back etc.) are detected, for example, it will judge with it not being in a dangerous state (suitably henceforth a safety state). When the person 2 judges with having come out of the bathroom 3, it may constitute so that the surveillance in the bathroom 3 may be stopped, until a motion of the person 2 is again detected in the bathroom 3. Since an erroneous decision can be prevented by detecting a noise etc., for example although the person 2 does not exist in the bathroom 3 if it does in this way, it is reliable.

[0036]

When a motion of the person 2 is suddenly lost in the organ bath 4, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is

because the person 2 sank or can surmise that it has fainted, for example. If in other words it is such a judging standard, when the person's 2 breathing will be detected, it will judge with it not being in a dangerous state (suitably henceforth a safety state).

[0037]

The standard of a judgment of the dangerous condition of the person 2 by the risk decision part 25 is good to make it set up in consideration of the following. For example, when breathing is detected and the cycle which a breathing pattern has for a short time is confused. Or since it can surmise that they are cerebrovascular disease, such as heart diseases, such as lung diseases, such as spontaneous pneumothorax and bronchial asthma, and congestive heart failure, or cerebral hemorrhage, for example when the cycle which a breathing pattern has changes rapidly, it sets up judge with it being in a dangerous state. Since it can surmise that the person's 2 breathing stopped when disappearance of a breathing pattern continues, it sets up judge with it being in a dangerous state. And since a situation in which the person 2 is troubled with a certain reason, and is rioting can be guessed when the body motion of the person 2 instead of a breathing pattern occurs frequently for a short time, it sets up judge with it being in a dangerous state.

[0038]

With reference to drawing 4, the example of a normal and unusual breathing pattern is explained. A normal breathing pattern is a periodic pattern as shown in drawing 4 (a). However, the range normal as a breathing rate for 1 minute in the case of an adult is about 10 to 20 times. An unusual breathing pattern is a breathing pattern considered to produce chain stokes (Cheyne-Stokes) breathing, central hyperventilation, ataxic breathing, large breathing of dregs MAURU (Kussmul), etc. when the obstacle has occurred inside of the body physiologically, for example.

[0039]

The breathing pattern of central hyperventilation is shown in drawing 4 (c), and the breathing pattern of ataxic breathing is shown for the breathing pattern of Cheyne-Stokes breathing in drawing 4 (b) at drawing 4 (d), respectively.

Furthermore, the name of a disease or the disease part at the time of being generated by the above-mentioned unusual breathing pattern is shown in drawing 5.

[0040]

The risk decision part 25 is good to distinguish whether the person's 2 breathing pattern belongs to which above-mentioned breathing pattern using the frequency of breathing of each breathing pattern and appearance frequency differing from sounding, and to judge the person's 2 dangerous condition. It is good to save the above breathing patterns at the storage parts store 31. By doing in this way, it can be easily judged by comparing with these patterns whether the person's 2 breathing is normal.

[0041]

Furthermore, it judges with the person 2 doing unusual breathing and the risk decision part 25 being in a dangerous state, when it judges with belonging to the breathing pattern considered that the person's 2 breathing arises when the obstacle has occurred inside of the body physiologically. The breathing pattern considered to produce in **** which the obstacle has generated inside of the body physiologically is a breathing pattern explained, for example by drawing 4. The person's 2 dangerous condition judged in this way is good to output to the output unit 36 or the alarm equipment 38 by the control section 21 for example. The contents outputted are the name of a disease, a disease organ, a disease part, etc. which are considered when it comes to the person's 2 detected breathing rate (cycle), the frequency of a motion, and the name of an unusual breathing pattern and the cause of the breathing.

[0042]

It returns and explains to drawing 2. When the person 2 is in a dangerous state, the risk decision part 25 is constituted based on a decision result so that an alarm signal may be outputted. An alarm signal is typically outputted to the below-mentioned alarm equipment 38.

[0043]
Here, the example of the alarm signal which the risk decision part 25 outputs is explained. When the state where it has judged with the dangerous state outputs the internal alarm signal as the 1st alarm signal when the 1st carries out prescribed period progress, and the 2nd of a period longer than the 1st prescribed period carries out prescribed period progress, the risk decision part 25 is constituted so that the external alarm signal as the 2nd alarm signal may be outputted. In outputting an external alarm signal, it becomes conditions that the internal alarm signal was outputted within the 2nd prescribed period. The 1st prescribed period and the 2nd prescribed period may be set, for example by time, and may be set with the acquired three-dimensional information number. When it sets by time, the 1st prescribed period is preferably made into about 5 to 10 seconds for 3 to 15 seconds, for example, and the 2nd prescribed period is about 10 to 20 seconds preferably for 10 to 30 seconds, for example. For example, when the 1st prescribed period is carried out, a frame number shows this and the acquisition interval of three-dimensional information is made into per second 1 time for the 2nd prescribed period for 15 seconds for 8 seconds, an internal alarm signal is 8 times and an external alarm signal is 15 times. The risk decision part 25 may be constituted so that the external alarm signal as the 2nd alarm signal may be outputted, when it outputs the internal alarm signal as the 1st alarm signal when there is the number of times judged to be a dangerous state among the predetermined number of times in the 1st number of times, and there is the 2nd number of many number of times from the 1st number of times. When the predetermined number of times considers it, for example as 15 to 25 times, the 2nd number of times is [the 1st number of times] good to use ten to about 20 about 5 to 10 times.
[0044]
An internal alarm signal is a thing for checking the existence of abnormalities, for example comparatively slight alarm 2, for example, person, or demanding cautions from him. When the risk decision part 25 outputs an internal alarm signal, the indoor monitoring instrument 1 is constituted from the loudspeaker which is not illustrated [with which the bathroom 3 was equipped] by the alarm equipment 38, for example so that voice response of the message of "whether it is OK" may be carried out. An external alarm signal is a serious alarm signal as compared with an internal alarm signal. Hereafter, when not distinguishing an internal alarm signal and an external alarm signal in particular, it is only called an alarm signal.
[0045]
The arithmetic unit 20 is provided with the alarm equipment 38 which emits an alarm. The alarm equipment 38 comprises inputting an alarm signal so that an alarm may be emitted. The alarm equipment 38 is good to constitute so that an alarm may be emitted, when the risk decision part 25 judges that the person 2 is in a dangerous state, for example, or when abnormalities, such as failure, occur in the indoor monitoring instrument 1. The alarm equipment 38 is constituted so that the alarm of a different kind may be emitted according to the inputted alarm signal. An alarm which is specifically different for every kind of inputted alarm signal, for example is set up. In other words, the alarm equipment 38 is with the inputted internal alarm signal and an external alarm signal, and is set up emit an alarm different, respectively. Thereby, the user (administrator) of a device can recognize easily that the person 2 is in a dangerous state, for example with the emitted alarm, for example. Since it receives unusually and can respond promptly by doing in this way, reliability can be improved. The arithmetic unit 20 is good to constitute via the interface 37, so that generating of an alarm may be notified outside, when the alarm equipment 38 operates. Although the alarm equipment 38 is illustrated as external, it is good also as built-in in this figure.
[0046]
It has the interface 37 for the arithmetic unit 20 to communicate with the exterior. The interface 37 is constituted so that it can report outside, when an alarm is emitted, for example by the alarm equipment 38. A report is based on the strength of the light which includes a sound, a character, a sign, and interior illumination, for example, or vibration. The interface 37 is provided with the function

connected to communication lines, such as a general telephone line, an ISDN circuit, a PHS circuit, or a cellular-phone circuit. That is, when the indoor monitoring instrument 1 is installed in the home, for example, distant medical facilities, such as a place, for example, a hospital etc., can be notified by using the above-mentioned communication line. even if it was a place which is distant from the place in which the indoor monitoring instrument 1 was installed, for example by doing in this way, the alarm was emitted by using the above-mentioned communication line -- since it can report easily, it is effective. The control section 21 is provided with a voice response function, and it may be made to notify the condition of an alarm or the person 2 to a third party with a sound via the interface 37.

[0047]
according to the indoor monitoring instrument 1 of a 1st above embodiment, detect the person's 2 position, and a motion and the person 2 breaks down also from a bathroom -- etc. -- a dangerous state can be judged certainly and promptly. Since the sinking condition in an organ bath is detectable, early detection is possible. When the person 2 is in a washing place, even if it detects ****, when the appeal into a bathroom is performed slowly, unnecessary appeal and report are reduced and the person 2 is in an organ bath, By the person's 2 room, it is possible to choose correspondence and it can be compatible in use of a comfortable bathroom, and emergency correspondence by quiet, such as giving priority to a quick report.
[0048]
Although the case where an indoor monitoring instrument was applied to the bathroom 3 was explained as an example above, application of an indoor monitoring instrument may not be restricted above, for example, may be the interior of a room of a toilet and an ordinary home, a bedroom, or a sickroom of a hospital. Hereafter, the example in the case of installing an indoor monitoring instrument in a toilet is explained.
[0049]
Drawing 6 is a typical outline view of the indoor monitoring instrument 201 as a monitoring instrument in space which is a 2nd embodiment by this invention. The indoor monitoring instrument 201 is the same composition as the indoor monitoring instrument 1 mentioned above. In this embodiment, an object domain is the toilet 203.
[0050]
The toilet 203 is the closed space surrounded by the wall surface in the four quarters like the bathroom 3. The toilet bowl 204 approaches the wall surface side which meets the entrance 206, and the toilet 203 is arranged. In other words, the toilet bowl 204 is installed in the inner part of the toilet 203. The three-dimensional sensor 10 is arranged in the upper part of the toilet 203. The upper part of the toilet 203 is the upper part of a ceiling or a wall surface typically. The graphic display shows the case where it arranges to the corner which a ceiling and a wall surface form.
[0051]
Although the risk decision part 25 mentioned above in drawing 2 is constituted similarly, the judging standard set up for every position is [the part] good here to set to every [of the about 204 toilet bowl near position 204' and near the entrance] position 207'.
[0052]
Here, the judging standard of the dangerous state in the case of the indoor monitoring instrument 201 is explained. The standard judge that is in a dangerous state, for example in position 207' near the entrance. When the amplitude of a motion of the state where in other words body motions (for example, motion etc. which moves to the toilet bowl 204 from the entrance 206) are detected to the person 2 with large amplitude of a motion of the person 2 becomes small, When a motion of the person 2 is lost suddenly, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is because the person 2 fell or can surmise that it fainted the same with having mentioned above with the indoor monitoring instrument 1, for example. When a motion of the person 2 is similarly lost after movement in the entrance 206 was

detected, it is made not to judge with a dangerous state. This is because the person 2 can judge with having come out of the toilet 203.

[0053]

In about 204-toilet bowl position 204', when a motion of the person 2 is lost suddenly, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is because it can surmise that the person 2 has fainted, for example. If in other words it is such a judging standard, when the person's 2 breathing will be detected, it will judge with it not being in a dangerous state. Namely, when the person 2 has done his business, for example (when sitting on the toilet seat of the toilet bowl 204, or while standing in front of the toilet bowl 204). Fundamentally, like the case of the above-mentioned organ bath 4, the person 2 is that (quiet state) which does not carry out a body motion, and if breathing is detected even if there is no big motion, he can guess a safety state. About the judgment of breathing, since it is the same as that of the indoor monitoring instrument 1, explanation is omitted.

[0054]

The above indoor monitoring instruments 201 of a 2nd embodiment, What the person's 2 size can advance into the toilet as an object domain, and a series of motions whether it is in the thing state (the seat which stands is and it has broken down from which position) whose person 2 is how or the person 2 is moving, and whether it left can be followed.

[0055]

The three-dimensional sensor 10 is explained here. The three-dimensional sensor 10 can acquire the three-dimensional information in an object domain by non-contact typically. Hereafter, this embodiment explains FG sensor used as a three-dimensional sensor.

[0056]

With reference to the notional perspective view of drawing 7, the FG (fiber grating) sensor 101 used as the three-dimensional sensor 10 suitable for the indoor monitoring instruments 1 and 201 of this embodiment is explained. The FG sensor 101 can acquire the three-dimensional information on the subject (person 2) which exists in an object domain. That is, it is constituted so that distribution of the height of a subject can be measured. Here, the flat surface 102 and a subject are explained for the inside of an object domain as the object 103 for explanation.

[0057]

The FG sensor 101 is provided with the following.

The luminescent spot projection device 110 as a projection means which projects two or more luminescent spots on an object domain.

The imaging device 111 as an imaging means which picturizes the pattern 110a formed by projection of the luminescent spot projection device 110.

The patterns 110a are two or more luminescent spots typically arranged in the shape of a tetragonal lattice. The shape of a luminescent spot is an approximate circle form containing an ellipse form.

[0058]

The object 103 in a figure is laid on the flat surface 102. The rectangular coordinate system XYZ is taken and the object 103 is put on the 1st quadrant of an XY coordinate system so that XY axis may be placed in the flat surface 102. On the other hand, above the flat surface 102, the luminescent spot projection device 110 and the imaging device 111 are arranged on the Z-axis in a figure. The imaging device 111 picturizes the object 103 on which the pattern 110a was projected by the luminescent spot projection device 110.

[0059]

The imaging device 111 is provided with the following.

Image formation lens 111a.

Image sensor 115.

The image sensor 115 is a CCD camera typically. Typically, the image formation lens 111a of the imaging device 111 is arranged so that the optic axis may be in agreement with the Z-axis. And the

image formation lens 111a carries out image formation of the image of the pattern 110a on the flat surface 102 or the object 103 to image formation face 115' (image plain) of the image sensor 115. Image formation face 115' is a field which intersects perpendicularly with the Z-axis typically. xy rectangular coordinate system is taken in image formation face 115', and the Z-axis passes along the starting point of xy coordinate system. At the image formation lens 111a and the equal distance, the luminescent spot projection device 110 is arranged from the flat surface 2 at the place which only the distance d (base length d) separated from the image formation lens 111a to the negative direction of the Y-axis. The pattern 110a which two or more luminescent spots 110b form with the luminescent spot projection device 110 is projected on the object 103 and the flat surface 102. y shaft orientations are also base line directions of the trigonometry used for the operation of the height later mentioned by drawing 9.
[0060]
The image sensor 115 is a CCD image sensor typically. The element of CMOS structure other than CCD is announced briskly these days, and, naturally it is usable also in them. There are some which were especially provided with the function of inter-frame difference ** or binarization into these at the element itself, and use of these elements is preferred.
[0061]
The control device 114 is connected to the image sensor 115. In other words, the imaging device 111 is connected to the control device 114. The control device 114 controls the FG sensor 101 whole. Although the control device 114 is typically installed in the imaging device 111 and a different body, it may be constituted in one. The miniaturization of a device can be attained if it does in this way. The control devices 114 are computers, such as a personal computer, typically. In the control device 114, the image processing device 117 which acquires the image of the pattern picturized by the imaging device 111 is incorporated.
[0062]
Furthermore in the control device 114, the height operation part 118 which calculates the height of the object 103 as a subject by trigonometry based on the pattern image and reference image which were picturized by the imaging device 111 is incorporated. Here, although a reference image and a pattern image are images picturized, for example by the imaging device 111, they are a concept also including the information on the position on each image sensor 115 (or image formation face 115') of a reference image and a pattern image. That is, a reference image and a pattern image are images of the pattern 110a formed by projection of the luminescent spot projection device 110. Here a reference image is an image of the pattern 110a in case the object 103 does not exist in the flat surface 102, and a pattern image is an image of the pattern 110a when the object 103 exists in the flat surface 102. That is, a reference image is an image which shows the reference position of each luminescent spot 110b of the pattern 110a. A reference image is good to save beforehand at the image processing device 117. Here, a reference image is not as what is called an image, for example, and is good to make it save in the form of the information on positions about the position of each luminescent spot 110b, such as coordinates. If it does in this way, when detecting the movement magnitude of a luminescent spot based on the pattern image and reference image which are mentioned later, since what is necessary is just to compare coordinates and the direction of a luminescent spot, for example, processing becomes simple.
[0063]
The imaging device 111 is good to have the filter 111b which dims the light of wavelength other than the periphery of the wavelength of the laser luminous flux L1 generated by the below-mentioned light flux generating part 105 (refer to drawing 10). The filters 111b are light filters, such as an interference filter, and are typically good to arrange on the optic axis of the image formation lens 111a. If it does in this way, since the luminous intensity of the pattern 110a projected from the luminescent spot projection device 110 among the lights which receive light to the image sensor 115 goes up relatively, the imaging device 111 can reduce the influence by disturbance light. The laser

luminous flux L1 generated by the light flux generating part 105 is the light flux of infrared light laser typically. It may irradiate with the laser beam L1 continuously, and may irradiate with it intermittently. In glaring intermittently, the image pick-up by the imaging device 111 is synchronized with the timing of an exposure, and it is made to perform it.

[0064]

The FG sensor 101 is good to constitute so that it may become irregular, in order to distinguish from disturbance light, when picturizing the pattern 110a with the imaging device 111. Abnormal conditions are the operation which repeats periodically the luminescence (exposure) stop of the laser luminous flux L1 by the light flux generating part 105, and performs it, for example. In this case, the luminescence stop of the laser luminous flux L1 may carry out the luminescence stop of the light source, for example, and may be made to carry out a luminescence stop by rotating a gobo and a slit. In this case, the influence of disturbance light can be remarkably reduced by taking out the light-receiving signal in sync with these abnormal conditions. It may be made for abnormal conditions to also change the output of the laser luminous flux L1 by the strength of disturbance light furthermore in addition to ****. It may be made for the image processing device 117 to generate the signal which deducted the light-receiving signal when not irradiating with the laser luminous flux L1 from the light-receiving signal when irradiating with the laser luminous flux L1. Thereby, the influence of disturbance light can be reduced. In order to secure reliability, the FG sensor 101 may constitute modulation operation so that the output signal of a multiple-times deed and its average may be used as acquired data, i.e., a pattern image.

[0065]

Here, an operation of the FG sensor 101 is explained with reference to drawing 7. First, the concept of measurement of the height of the object 103 is explained. In the portion in which the object 103 exists, the pattern 110a projected on the flat surface 102 by the luminescent spot projection device 110 is interrupted by the object 103, and does not arrive at the flat surface 102. If the object 103 exists here, the luminescent spot 110b on which it should be projected by the point 102a on the flat surface 102 will be projected by the point 103a on the object 103. From the place from which the image formation lens 111a and the luminescent spot projection device 110 have separated only the distance d (base length d) again when the luminescent spot 110b moved to the point 103a from the point 102a, In image formation face 115' up, the place which should be carried out image formation carries out image formation to point 102a' (x, y) at point 103a' (x, y+delta). That is, when the time of the object 103 not existing and the object 103 exist, the image of the luminescent spot 110b will move only the distance delta to y shaft orientations.

[0066]

As this shows drawing 8, for example, only delta will move the image of the luminescent spot 110b which carried out image formation to y shaft orientations with the object 103 with height at image formation face 115' of the image sensor 115.

[0067]

The position of the point 103a on the object 103 can specify the FG sensor 101 in three dimensions by measuring this delta. That is, the height of the point 103a is known. Thus, if a certain point does not exist [the object 103], when measuring a difference with the actual image formation position on image formation face 115 'the point which should be turned image formation up and the image formation face 115', if it is distributed and the height of the object 103 puts in another way, three-dimensional shape is measurable. Or the three-dimensional coordinates of the object 103 are measurable. If the pitch of the pattern 110a, i.e., the pitch of the luminescent spot 110b, is made fine to such an extent that the correspondence relation of the luminescent spot 110b does not become unknown, distribution of the height of the object 103 can be measured so in detail.

[0068]

Here, the operation of the height by the height operation part 118 is explained. The height operation part 118 reads a pattern image and a reference image, and measures the movement magnitude delta

of the image of the luminescent spot 110b. Measurement of the movement magnitude delta creates the difference image of a pattern image and a reference image first. And the movement magnitude delta of the position of the image of a luminescent spot corresponding from this difference image is measured. The movement magnitude delta is calculated by, for example, calculating the pixel number (what pixel moved?) which the position of the image of the luminescent spot 110b moved. Although explained by the case where a difference image is created, the above saves the reference image in the form of the information on the position of each luminescent spot 110b, is comparing the information on the position of each luminescent spot 110b of a pattern image with the information on the position of the luminescent spot 110b of a reference image, and may measure the movement magnitude delta. If it does in this way, since it is not necessary to generate a difference image, processing can be simplified. The height operation part 118 calculates the height of the object 3 by trigonometry based on the movement magnitude delta. With reference to drawing 9, calculation of the height of the object 103 by trigonometry is explained.

[0069]

Drawing 9 is the imaging device 111, the luminescent spot projection device 110, the object 103, and the side view that looked at the relation with the flat surface 102 to the X axial direction (refer to drawing 7). Here, it explains by the case where the height of the object 103 is Z1. The center (the center of the source of pattern light) of the luminescent spot projection device 110, and the center of the image formation lens 111a, Detach only the distance d in parallel with the flat surface 102, and it is arranged, and the distance to image formation face 115' (image sensor 115) from the image formation lens 111a I (El) (almost equal to the focus of the image formation lens 111a), h and the height from the flat surface 102 of the point 103a of the object 103 of the distance from the image formation lens 111a to the flat surface 102 are Z1. the result by which the object 103 was placed on the flat surface 102 -- the image formation face 115 -- suppose that it moved to 'the point 103a that upper point 102a' left only delta'.

[0070]

If the point that the line which connects the center and the point 103a of the image formation lens 111a in a figure intersects the flat surface 102 is made into 102a″, the distance D of the point 102a and point 102a.″ If triangle 103a'-102a'-111a and triangle 102a″-102a-111a are observed, it will be D=delta-h/l, and if triangle 111a-110-103a and triangle 102a″-102a-103a are observed, it will be D=(d-Z1)/(h-Z1). If Z1 is calculated from both this type, it will become like a following formula.

$Z1=(h^2\text{anddelta})/(d\text{-}l\text{+}h\text{-}delta)$ ...... (1)

As mentioned above, the height of the object 103 is computable.

[0071]

The past fixed count operation was done or the height of the object 103 calculated by the height operation part 118 is good also as the moving average deviation of the height calculated within past fixed time, or period average rates. By doing in this way, the sudden noise by flicker of the daylight inserted from random noise or a window, etc. can be reduced, and the reliability of the height of the calculated object 103 improves.

[0072]

As mentioned above, the FG sensor 101 picturizes the pattern 110a formed in the object domain by projection of the luminescent spot projection device 110 with the imaging device 111, Since the height of a subject is calculated by the height operation part 118 by trigonometry based on this pattern image and reference image that were picturized, the height of a subject is measurable. Since the FG sensor 101 can measure the height of a subject in respect of the plurality in an object domain, it can measure distribution of the height of a subject. The temporal change of level distribution is also measurable by measuring distribution of this height, for example with a certain time interval.

[0073]

With reference to the typical perspective view of drawing 10, the luminescent spot projection device

110 suitable for the FG sensor 101 is explained. The luminescent spot projection device 110 is provided with the following.
The light flux generating part 105 as a luminous flux generating means which generates coherent light flux.
Fiber grating 120 (only henceforth the grating 120).
Coherent light flux is infrared light laser typically. The light flux generating part 105 is constituted so that a parallel pencil may be generated. The light flux generating part 105 is a semiconductor laser device typically constituted including an unillustrated collimating lens, and the parallel pencil generated is the laser luminous flux L1. And the section of the laser luminous flux L1 is approximate circle-shaped light flux. If substantially parallel to a parallel pencil, it is good and light flux near in parallel is also included here.
[0074]
Here, the grating 120 is explained by the case where it is arranged in parallel (it is right-angled to the Z-axis) with the flat surface 102. The laser beam L1 is entered in Z shaft orientations at the grating 120. Then, the laser beam L1 serves as a divergent wave, with each optical fiber 121, after it condenses in a field with the lens effect, spreads, and goes and interferes, and the pattern 110a is projected on the flat surface 102 which is a surface of projection. Arranging the grating 120 in parallel with the flat surface 102 is arranging so that the flat surface containing the axis of each optical fiber 121 of FG element 122 which constitutes the grating 120, and the flat surface 102 may become parallel.
[0075]
The grating 120 is constituted including two FG elements 122. In this embodiment, the flat surface of each FG element 122 is mutually parallel. Hereafter, the flat surface of each FG element 122 is called element flat surface. In this embodiment, the axis of the optical fiber 121 of two FG elements 122 lies at right angles mostly mutually.
[0076]
As for FG element 122, several 10 - about 100 numbers put in order and constitute in parallel the optical fiber 121 whose diameters are several 10 microns and about 10 mm in length in a sheet shaped, for example. Two FG elements 122 may contact, may be arranged, and may vacate and arrange distance to the normal line direction of each element flat surface. In this case, mutual distance of two FG elements 122 is made into the grade by which projection of the pattern 110a is not hindered. Typically, the laser luminous flux L1 is vertically entered to the element flat surface of the grating 110.
[0077]
As mentioned above, the luminescent spot projection device 110 can miniaturize an optical case, without needing a complicated optical system, since the grating 120 constituted including two FG elements 122 serves as an optical system. Furthermore, the luminescent spot projection device 110 is using the grating 120, is simple composition and can be projected on the flat surface 102 by using two or more luminescent spots 110b as the pattern 110a.
[0078]
Although the pattern was explained as two or more luminescent spots above, it is good also as two or more luminescent lines. That is, it may be made to measure the height of a subject using an optical cutting method. In this case, it has the luminescent line projection device 210 as a projection means which projects a luminescent line on an object domain instead of the luminescent spot projection device 110. Although the number of the luminescent lines projected with the luminescent line projection device 210 is plurality typically, it may be one. Hereafter, in two or more case, a luminescent line is explained. Hereafter, the thing at the time of using an optical cutting method for the FG sensor 101 is explained as FG sensor 101'.
[0079]
FG sensor 101' is explained with reference to the typical key map of drawing 11. The luminescent

line projection device 210 projects two or more luminescent lines 210b on the flat surface 102 in parallel. The imaging device 111 picturizes the object 103 and the flat surface 102 where the pattern 210a was projected by the luminescent line projection device 210. Two or more luminescent lines 210b are projected at equal intervals. Two or more luminescent lines 210b form the pattern 210a. The direction of the luminescent line 210b and the base line direction of trigonometry are almost vertical. That is, the direction of the luminescent line 210b is vertical to the y-axis. Here, it may be one although the luminescent line is made into two or more. In this case, FG sensor 101' can be constituted still more simply.

[0080]

Here, the concept of the height measurement of the object 103 using an optical cutting method is explained. In the portion in which the object 103 exists, the pattern 210a projected on the flat surface 102 by the luminescent line projection device 210 is interrupted by the object 103, and does not arrive at the flat surface 102. If the object 103 does not exist here, the luminescent line on which it should be projected by the point 102a on the flat surface 102 is projected by the point 103a on the object 103. the luminescent line moved to the point 103a from the point 102a -- image formation face 115from place from which image formation lens 111a and luminescent line projection device 210 have separated only distance d (base length d)' -- in a top, the place which should be carried out image formation carries out image formation to point 102a' (x, y) at point 103a' (x, y+delta). That is, when the time of the object 103 not existing and the object 103 exist, a luminescent spot will move only the distance delta to y shaft orientations.

[0081]

As this shows drawing 12, for example, only delta will move the image of the luminescent line 210b which carried out image formation to y shaft orientations with the object 103 with height at image formation face 115' of the image sensor 115. The position of the point 103a on the object 103 can specify in three dimensions by measuring this delta like the FG sensor 101. That is, the height of the point 103a is known. If the pitch of the pattern 210a, i.e., the pitch of the luminescent line 210b, is made fine to such an extent that the correspondence relation of the luminescent line 210b does not become unknown, distribution of the height of the object 103 can be measured so in detail. Calculation of the height by the height operation part 118 is the same as that of explanation of drawing 9.

[0082]

As mentioned above, FG sensor 101' makes a pattern two or more luminescent lines, compared with the case where a pattern is made into a luminescent spot, it is measuring movement of a luminescent line, and can measure movement of the arbitrary points of a luminescent line, and can recognize the continuous shape of the direction of a luminescent line. In other words, the resolution of measurement of the X axial direction in a figure can be improved.

[0083]

With reference to the typical perspective view of drawing 13, the luminescent line projection device 210 suitable for FG sensor 101' is explained. The luminescent line projection device 210 is provided with the following.

The light flux generating part 105 mentioned above in drawing 10.

Fiber grating 220 (only henceforth the grating 220).

[0084]

Here, the grating 220 is explained by the case where it is arranged in parallel (it is right-angled to the Z-axis) with the flat surface 102. The laser beam L1 is entered in Z shaft orientations at the grating 220. Then, the laser beam L1 serves as a divergent wave, with each optical fiber, after it condenses in a field with the lens effect, spreads, and goes and interferes, and the pattern 210a is projected on the flat surface 102 which is a surface of projection. Arranging the grating 220 in parallel with the flat surface 102 is arranging so that the flat surface containing the axis of each

optical fiber 221 of 1st FG element 222 that constitutes the grating 220, and the flat surface 102 may become parallel, as later mentioned by drawing 14.

[0085]

The grating 220 is explained with reference to the mimetic diagram of drawing 14. (a) is a perspective view and (b) is a front view. The 1st fiber grating element 222 (henceforth 1st FG element 222) that turned the axis of each optical fiber 221 in the 1st direction v1 and as for which the grating 220 put two or more optical fibers 221 in order in parallel and planate, The 2nd fiber grating element 223 (henceforth 2nd FG element 223) that put two or more optical fibers 221 in order in parallel and planate towards the 2nd direction v2 that is different from the 1st direction v1 in the axis of each optical fiber 221, It is constituted including the 3rd fiber grating element 224 (henceforth 3rd FG element 224) that put two or more optical fibers 221 in order in parallel and planate towards the 3rd direction v3 that is different from the 1st direction v1 and the 2nd direction v2 in the axis of each optical fiber 221. In this embodiment, the flat surface of each FG elements 222, 223, and 224 is mutually parallel. Here, in order to identify each FG element, it is called the 1st FG element, the 2nd FG element, and the 3rd FG element. According to this embodiment, it has piled up in order of the 1st FG element, the 2nd FG element, and the 3rd FG element. however, it may pile up in order of other order, for example, the 1st FG element, inside, the 3rd FG element, and the 2nd FG element. Hereafter, the flat surface of each FG elements 222, 223, and 224 is called element flat surface.

[0086]

1st FG element 222, 2nd FG element 223, and 3rd FG element 224 are the same as FG element 122 mentioned above. In a graphic display, although each FG elements 222, 223, and 224 show the case where it contacts and arranges, they may vacate and arrange distance to the normal line direction of an element flat surface, respectively. In this case, mutual distance of each FG elements 222, 223, and 224 is made into the grade by which projection of the pattern 210a is not hindered.

[0087]

You make it pile up 1st FG element 222, 2nd FG element 223, and each other's 3rd FG element 224, and they constitute the grating 220. in addition -- being mentioned here -- it piles each other up -- making -- it is piled up so that each element flat surface of each FG elements 222, 223, and 224 may become almost parallel. In other words, by this embodiment, the grating 220 is laid on top of the order of 1st FG element 222, 2nd FG element 223, and 3rd FG element 224 so that each element flat surface may become parallel. The grating 220 is constituted so that the laser luminous flux L1 generated by the light flux generating part 105 may be made to penetrate. The laser luminous flux L1 is made to penetrate here in order of 1st FG element 222, 2nd FG element 223, and 3rd FG element 224. Typically, the laser luminous flux L1 is vertically entered to the element flat surface of the grating 220 (1st FG element 222).

[0088]

As shown in drawing 14 (b), in this embodiment, the 1st direction v1 and 2nd direction v2 lie at right angles mostly. The 3rd direction v3 makes it rotate from the 1st direction v1 in the field where only the predetermined angle theta is parallel to an element flat surface, and 3rd FG element 224 is piled up. The predetermined angle theta is later mentioned with reference to drawing 15.

[0089]

Here, the predetermined angle theta is explained with reference to drawing 15. The change of a luminescent spot by giving the predetermined angle theta first is explained. (a) explains by the case where the predetermined angle theta is theta 1, as shown in (b). (a) is a figure showing a part of pattern 210a' projected when this side is made to penetrate the laser luminous flux L1 from the ****** side of (b). By graphic display, about 10 degrees has shown theta 1 as reference. First, the luminescent spots 251, 252, 253, 254, and 255 which are a part of pattern 210a' projected when the predetermined angle theta is 0 degree are observed. And if the predetermined angle theta 1 is given to 3rd FG element 224, it will diffract to the straight line 251a which is a generation direction of

each luminescent spot in the direction of straight-line 251a' which makes the angle theta 1, respectively, and each above-mentioned luminescent spot will project a new luminescent spot. If it furthermore explains and the luminescent spot 251 will be observed, it will diffract in the direction of straight-line 251a', and the luminescent spot 251 will project new luminescent spot 251' on it.

[0090]

Thereby, since the diffraction direction of a luminescent spot changes with the predetermined angle theta, by some theta, it is parallel and two or more luminescent line sequences (only henceforth two or more luminescent lines) arranged at equal intervals and a dense luminescent spot array can be projected, for example. In other words, two or more luminescent lines can be easily projected by adjusting the predetermined angle theta to 3rd FG element 224.

[0091]

With reference to the mimetic diagram of drawing 16, the predetermined angle theta is adjusted and the example in the case of making a pattern into two or more luminescent lines is explained. A luminescent line is formed because two or more luminescent spots gather linearly. an FG element -- low -- diffraction efficiency is uniformly near over the high order diffracted light from the next, and since the luminescent line is formed because two or more luminescent spots gather, even if the luminosity of the center section of the luminescent line says in the direction of an end of a luminescent line from a center section, it cannot change easily. That is, a luminescent line with uniform luminosity can be projected. When using two or more luminescent lines, the predetermined angle theta is preferably good most preferably to consider [0.1-10-degree / 1-8-degree] it as about 5 degrees. It becomes two or more luminescent lines same also in the case of theta= 85 degrees. However, the pattern projected turns into a pattern made to rotate (b) of 90 degrees in this case.

[0092]

As mentioned above, the luminescent line projection device 210 is making 1st FG element 222, 2nd FG element 223, and 3rd FG element 224 penetrate the laser luminous flux L1, and since the pattern 210a of two or more luminescent lines can be projected, it can be constituted simply. The luminescent line projection device 210 can miniaturize an optical case, without needing a complicated optical system, since the grating 220 constituted including 1st piled-up FG element 222, 2nd FG element 223, and 3rd FG element 224 serves as an optical system. Since it is constituted in this way, it can project on the flat surface 102 by using two or more luminescent lines as the pattern 210a. Since a luminescent line is formed by set of a luminescent spot, two or more luminescent lines with uniform luminosity can be projected. For this reason, it is predominant when measuring movement of a luminescent line like this embodiment.

[0093]

For example, it explained in the case of the luminescent line projection device 210 mentioned above, but it is not restricted to this, a luminescent line projection device may be constituted using a cylindrical lens, a slit, etc. so that two or more luminescent lines may be projected as the pattern 210a.

[0094]

The luminescent line projection device 310 is shown in drawing 17 as another example of a luminescent line projection device. The luminescent line projection device 310 has the optical element 311 formed with optical glass. The convex 311a section of an approximately triangle is formed in the incidence side of light flux for a section, and, as for the optical element 311, the cylinder side 311b is further formed in the incidence side tip part of the light flux of the heights 311a. The optical element 311 is a PAUERU lens currently typically indicated by US4826299. In such a cylinder side 311b of the optical element 311, a luminescent line can be projected on an object domain by light flux generating part 105' by entering laser-luminous-flux L1' of a path smaller than the curvature radius of this cylinder side 311b. Two or more luminescent lines can be projected on the object domain side of the optical element 311 by arranging a diffraction element, for example,

the FG element mentioned above. The luminescent line projection device 310 can project two or more luminescent lines with uniform luminosity by using such an optical element 311.
[0095]
It may be made for FG sensor 101' to picturize two or more pattern images projected on the position which is fully a high speed compared with a motion of a subject, and scans a luminescent line to y shaft orientations in a figure, and from which a luminescent line differs in an object domain in the object domain, as shown in the mimetic diagram of drawing 18. In this case, it is considered as luminescent line projection device 210' which can scan the luminescent line which projected the luminescent line generating means to the specific direction of an object domain. It is good also as a pattern image which is an image of the above-mentioned pattern 210a (refer to drawing 11) by the combination of two or more pattern images picturized in this way in this case. In other words, as shown in (b), the same pattern image as the pattern image of the object domain where it was projected, two or more above-mentioned luminescent lines 210a, i.e., pattern, may be generated by combining the pattern image of the luminescent line projected on a different position. If it furthermore explains, it will be generating the pattern image of the object domain where two or more luminescent lines were projected, for example like a graphic display combining the pattern image acquired to the time t1, t2, t3, and t4. That is, while the luminescent line is scanning the inside of an object domain, the number of times which acquired the pattern image turns into a number of the image of the luminescent line on the pattern image put together. There is one luminescent line to scan typically.
[0096]
Here, with reference to the typical outline view of drawing 19, the example of installation of the FG sensor 101 in the case of the indoor monitoring instrument 1 is explained. The luminescent spot projection device 110 and the imaging device 111 are arranged to the top both ends of the wall surface 64 of the bathroom 3. In the graphic display, the imaging device 111 is arranged at the person's 2 end by which the luminescent spot projection device 110 has been about arranged for the luminescent spot projection device 110 at the end by the side of the head upper part, and the end by the side of reverse. As shown in (b), the luminescent spot projection device 110 has projected the pattern 110a on the organ bath 4 of the bathroom 3, and the washing place 7. It is set up and the field angle of the imaging device 111 is so that the bathroom 3 whole can be picturized. The control device 114 may also be incorporated in the control section 21 explained by drawing 2. The composition of the indoor monitoring instrument 1 can be simplified by doing in this way.
[0097]
Typically, the luminescent spot projection device 110 leans and installs the optic axis (projecting direction of laser luminous flux) to the perpendicular direction of an object domain like a graphic display. By doing in this way, the pattern 110a can be projected broadly easily. It can perform easily detaching and installing the distance of the imaging device 111 and the luminescent spot projection device 110, for example. In other words, it can perform taking long base length easily. The imaging device 111 leans and installs an optic axis to the perpendicular direction of an object domain similarly. By doing in this way, the bathroom 3 whole can be picturized easily. It can perform taking long base length easily. Here, as mentioned above, the luminescent spot projection device 110 and the imaging device 111 may be about installed in parallel to said perpendicular direction, although each optic axis is leaned and installed to the perpendicular direction of the level surface. Each optic axis of each other may be turned in parallel, and may be installed.
[0098]
The imaging device 111 and the luminescent spot projection device 110 are good to detach and install distance to some extent. By doing in this way, since the distance d (base length d) mentioned above in drawing 7 becomes long, change can be detected sensitively. Here, long base length is taken by arranging to the top both ends of the wall surface 64. It may be short although taking for a long time is preferred as for base length. However, as mentioned above, although it becomes difficult

to detect the small movement toward breathing etc. in this case, if the person's 2 centroid position is detected, the small detection which moves (breathing) is also possible. Here, although it attached FG sensor 101 and being explained, it may install similarly about FG sensor 101'.

[0099]

The three-dimensional information in an object domain is correctly acquirable by using the above FG sensors 101 as the three-dimensional sensor 10. The anything which can acquire the three-dimensional information not only on the FG sensor 101 mentioned above but an object domain, the three-dimensional sensor 10 may be good, for example, may be a sensor using moire, a sensor using a stereo camera, and a sensor using two or more distance sensors.

[0100]

The sensor using moire can acquire three-dimensional information by, for example, picturizing the moire pattern formed using two slits. By using moire, since the level distribution of the direction of stripes can be measured continuously, highly precise three-dimensional information is acquirable. Moire is a coarse striped pattern produced according to the difference of both spatial frequency, when two regular intensity distribution is piled up. There are moire of the sum produced by the sum of two intensity distribution and moire of the product produced by a product, the photograph which exposed two regular distribution doubly can realize the former, and the latter should just look at the transparency which recorded each regular distribution in piles. A motion of the person 2 is also detectable with high precision by using the information on the phase of a moire pattern.

[0101]

The sensor using a stereo camera is acquiring a stereo image and searching for the corresponding points on this stereo image, for example with two CCD cameras, and can measure the level distribution of an object domain by trigonometry. That is, the three-dimensional information on an object domain is acquirable. Since three-dimensional information is acquired based on a two-dimensional picture, it is highly precise.

[0102]

The sensor using two or more distance sensors can acquire three-dimensional information by measuring the distance of two or more point of measurement of installation and an object domain for two or more distance sensors corresponding to the required point of measurement. By using distance sensors, the influence of disturbance light can acquire three-dimensional information correctly few. Since there is no necessity for image processing, it can have simple composition. The distance sensors to be used may be the types which used trigonometry like an infrared sensor well fundamental anything, and, It may be an ultrasonic sensor and may be a type (what measures the time when light emits and comes back and measures distance) of a time TSUUFU light (Time-to-flight).

[0103]

[Effect of the Invention]

As mentioned above, the three-dimensional sensor which acquires the three-dimensional information in an object domain according to this invention, The height change detecting means which detects change of the height in said object domain based on said acquired three-dimensional information, The position detecting means which detects the position of a subject based on change of said detected height, The motion detecting means which detects a motion of said subject based on change of said detected height, Said subject is provided with a risk decision means to judge whether it is in a dangerous state, based on the position of said detected subject, and a motion, and it said risk decision means, Since it is constituted so that the judgment of whether to be in said dangerous state may be performed based on the judging standard set up for every position in said object domain, it not only can judge the dangerous state of a subject correctly, but it can provide the simple monitoring instrument in space.

[Brief Description of the Drawings]

[Drawing 1]It is a typical outline view of the indoor monitoring instrument which is a 1st embodiment

of this invention.
[Drawing 2]It is a block diagram showing the composition of the indoor monitoring instrument which is a 1st embodiment of this invention.
[Drawing 3]It is a schematic diagram which is used by a 1st embodiment of this invention and in which showing the waveform pattern of breathing.
[Drawing 4]It is a schematic diagram showing the waveform pattern of normal and unusual breathing in the case of drawing 3.
[Drawing 5]It is a figure showing the table of the name of a disease corresponding to the waveform pattern of unusual breathing in the case of drawing 4, or a disease part.
[Drawing 6]It is a typical outline view of the indoor monitoring instrument which is a 2nd embodiment of this invention.
[Drawing 7]It is a notional perspective view of FG sensor which is an embodiment of the invention.
[Drawing 8]It is a mimetic diagram explaining the image of the pattern which carried out image formation to the image formation face in the case of drawing 7.
[Drawing 9]It is a diagram explaining the operation of the height of the subject in the case of drawing 7.
[Drawing 10]It is a typical perspective view explaining the luminescent spot projection device in the case of drawing 7.
[Drawing 11]It is a notional perspective view of FG sensor using the optical cutting method which is an embodiment of the invention.
[Drawing 12]It is a diagram explaining the image of the pattern in the case of drawing 11.
[Drawing 13]It is a typical perspective view explaining the luminescent line projection device in the case of drawing 11.
[Drawing 14]They are the (a) perspective view explaining the grating in the case of drawing 13, and the (b) front view.
[Drawing 15]They are a mimetic diagram of the (a) pattern explaining the pattern projected by the grating of drawing 14, and a front view of the (b) grating.
[Drawing 16]It is a schematic plan view showing the pattern projected by the grating of drawing 14.
[Drawing 17]It is a typical perspective view showing another gestalt of the luminescent line projection device in the case of drawing 11.
[Drawing 18]It is a figure showing another gestalt of the luminescent line projection device in the case of drawing 11, and is an explanation **** mimetic diagram about the combination of the typical perspective view of (a) FG sensor, and the (b) pattern image.
[Drawing 19]They are (a) typical outline view explaining the example in the case of installing FG sensor which is an embodiment of the invention in a bathroom, and the (b) top view.
[Description of Notations]
1 Indoor monitoring instrument
2 Person
3 Bathroom
4 Organ bath
7 Washing place
10 Three-dimensional sensor
20 Arithmetic unit
21 Control section
22 Height change primary detecting element
23 Position detector
24 Motion detection part
25 Risk decision part
31 Storage parts store
38 Alarm equipment

101 FG sensor
101'FG sensor (thing using an optical cutting method)
102 Flat surface
103 Object
105 Light flux generating part
110 Luminescent spot projection device
110a Pattern
110b Luminescent spot
111 Imaging device
114 Control device
115 Image sensor
117 Image processing device
118 Height operation part
120 Grating
121 Optical fiber
122 FG element
201 Indoor monitoring instrument
203 Toilet
204 Toilet bowl
210 Luminescent line projection device
210a Pattern
210b Luminescent line
220 Grating
221 Optical fiber
222 The 1st FG element
223 The 2nd FG element
224 The 3rd FG element

[Translation done.]

TECHNICAL FIELD

[Field of the Invention]
This invention relates to the monitoring instrument in space for supervising change of the position of a subject, a motion, etc. which exists especially in space about the monitoring instrument in space which supervises a subject.
[0002]

[Translation done.]

PRIOR ART

[Description of the Prior Art]
The motion detection sensor is proposed from the former as a monitoring instrument which supervises change of a motion of the subject in the inside of space, for example, a bathroom, a toilet, etc., for example, a person. A typical example is a thing which divides into two or more part images the picture which picturized and acquired the picture in a bathroom, detects whether there is any motion of a subject from change of a luminosity and a color for every part image, and judges whether the person under bathing is moving by the situation of a motion of each part image. In the object for the interior of a room, the device which judges an indoor person's condition from a mutual output as a device which detects the condition of the person in a single room including a fall combining the infrared image sensor attached to the ceiling and the heat ray height sensor which attaches to a wall surface and makes fixed height detection area is proposed. This device can detect whether the person under staying in the room has taken the low posture, or the high posture is taken, it is in tipping condition, or that is not right by setting up the detection height area of the sensor of a wall surface suitably.
[0003]
There was a monitoring instrument which supervises a sleeping person's breathing by computing the movement magnitude of a pattern from the picture which projected the pattern on the sleeping person on a bed, and picturized the projected pattern continuously (for example, refer to patent documents 1.).
[0004]
[Patent documents 1]
JP,2002-175582,A (the five - 9th page, Drawing 13 [one to])
[0005]

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]
As mentioned above, the three-dimensional sensor which acquires the three-dimensional information in an object domain in this invention, The height change detecting means which detects change of the height in said object domain based on said acquired three-dimensional information, The position detecting means which detects the position of a subject based on change of said detected height, The motion detecting means which detects a motion of said subject based on change of said detected height, Based on the position of said detected subject, and a motion, it has a risk decision means to judge whether said subject is in a dangerous state, and said risk decision means is constituted so that the judgment of whether to be in said dangerous state may be performed based on the judging standard set up for every position in said object domain. Therefore, it not only can judge the dangerous state of a subject correctly, but it can provide the simple monitoring instrument in space.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
However, according to the above conventional devices, when the motion of a person had stopped, for example, it fell whether it was in the state which merely keeps still, and it was not able to be judged whether it was in a dangerous state.
[0006]
Then, it not only judges the dangerous state of a subject correctly, but an object of this invention is to provide the simple monitoring instrument in space.
[0007]

[Translation done.]

MEANS

[Means for Solving the Problem]
To achieve the above objects, the monitoring instrument 1 in space by invention concerning claim 1, For example, the one three-dimensional sensor 10 which acquires three-dimensional information in the object domain 3 as shown in drawing 1 and drawing 2; based on said acquired three-dimensional information, The height change detecting means 22 which detects change of height in the object domain 3; based on change of said detected height, The position detecting means 23 which detects a position of the subject 2 which carries out breathing, a body motion, and movement; based on change of said detected height, The motion detecting means 24 which detects movement toward breathing of the subject 2, a body motion, and movement; based on a position of said detected subject 2, and a motion, The subject 2 is provided with a risk decision means 25 to judge whether it is in a dangerous state, and it; risk decision means 25, It is constituted and so that a judgment of whether to be in said dangerous state may be performed based on a judging standard set up for every position in the object domain 3 the; object domain 3, The 1st field 7 judge that is in said dangerous state by the risk decision means 25 when a motion with large amplitude based on a body motion of the subject 2 and movement is no longer detected, When [at which a motion with small amplitude based on breathing of the subject 2 was confused] detected no longer at the time. Or have the 2nd field 4 that differs in the 1st field 7 judge that is in said dangerous state by the risk decision means 25 when the state where a motion with small amplitude based on breathing of the subject 2 is not detected carries out predetermined time continuation, or when a body motion of the subject 2 occurs frequently for a short time, and the; aforementioned judging standard, It judges with it being in said dangerous state, when a motion whose amplitude based on a body motion of the subject 2 and movement is large when it detects that the subject 2 is in the 1st field 7 by the position detecting means 23 is no longer detected, When it detects that the subject 2 is in the 2nd field 4 by the position detecting means 23. When [at which a motion with small amplitude based on breathing of ******** 2 was confused] detected no longer at the time. Or it is constituted so that it may judge with it being in said dangerous state, when the state where a motion with small amplitude based on breathing of the subject 2 is not detected carries out predetermined time continuation, or when a body motion of the subject 2 occurs frequently for a short time.
[0008]
Since it has the three-dimensional sensor 10, the height change detecting means 22, the position detecting means 23, and the motion detecting means 24 if constituted in this way, a position of the subject 2 and a motion are detectable. Have the risk decision means 25 and the risk decision means 25, Since it is constituted so that a judgment of whether to be in said dangerous state may be performed based on a judging standard set up for every position in the object domain 3, it not only can judge a dangerous state of a subject correctly, but it can provide a simple monitoring instrument in space.
[0009]

As mentioned above, the subject 2 carries out breathing, a body motion, and movement, and the; motion detecting means 24 comprises the monitoring instrument 1 in the space according to claim 1 so that breathing of the subject 2, a body motion, and movement may be detected. In this case, although the subject 2 which carries out breathing, a body motion, and movement is a person, for example, it may be an animal.

[0010]

If constituted in this way, since breathing of the subject 2 is detected, even when there is almost no motion of a subject, the motion detecting means 24 is detecting breathing, and can judge the safety, for example. That is, a dangerous state of a subject can be judged. Since a dangerous state of the subject 2 can also be judged by judging normality of the breathing, and abnormalities also from detected breathing, the reliability of a judgment of a dangerous state increases.

[0011]

As mentioned above, in the monitoring instrument 1 in the space according to claim 1, the motion detecting means 24 can detect movement of the subject 2.

To claim 2, like a statement in the monitoring instrument 1 in the space according to claim 1. It is good for detection of said breathing by the motion detecting means 24 to constitute so that a threshold of a predetermined maximum minimum may be set as both or either of amplitude and cycles of a periodic change of change of said height which was detected by the height change detecting means 22, it may judge whether it is breathing as compared with this threshold and breathing may be detected.

To claim 3, like a statement in the monitoring instrument 1 in the space according to claim 1 or 2.Said judging standard is a time of detecting that the subject 2 is in the 1st field 7 by the position detecting means 23, and when a motion of the subject 2 is no longer detected after movement of the subject 2 is detected near the entrance of the 1st field 7, it is good to constitute so that it may not judge with a dangerous state.

Like a statement to claim 4, as the monitoring instrument 1 in space given in any 1 paragraph of claim 1 thru/or claim 3 shows, for example to drawing 1, it is good in said object domain being the bathroom 3, the 1st field of; above being the washing place 7, and the 2nd field of; above being the organ bath 4.

To claim 5, like a statement in the monitoring instrument 1 in space of a statement, in any 1 paragraph of claim 1 thru/or claim 3. For example, as shown in drawing 6, it is good in said object domain being the toilet 203, the 1st field of; above being position 207' near the entrance, and the 2nd field of; above being position 204' near the toilet bowl.

[0012]

In the monitoring instrument 1 in space of a statement, in any 1 paragraph of claim 1 thru/or claim 5.The position detecting means 23 judges an existence region where the subject 2 exists based on said detected height change, It is a field including said judged existence region, and it is good to constitute so that a field where only a predetermined range expanded said existence region may be computed, priority may be given to said expanded field and a position of the subject 2 may be detected.

[0013]

Since a position of the object 2 will be detected from a field where a possibility that the subject 2 exists is high, for example if constituted in this way, time which detection of a position of the subject 2 takes can be shortened, and improvement in the speed of processing can be attained.

[0014]

To claim 6, like a statement in the monitoring instrument 1 in space of a statement, in any 1 paragraph of claim 1 thru/or claim 5. As shown in drawing 7 and drawing 11, the three-dimensional sensor 101 to said object domain For example, a luminescent line. Or the projection means 110 and 210 which project two or more luminescent spots and the imaging means 111 which picturizes a pattern formed by the; aforementioned projection; it has the height operation part 118 which

calculates height of said subject by trigonometry based on said picturized pattern image and a reference image.

[0015]

A luminescent line with which the three-dimensional sensor 101 was projected on said object domain by the projection means 110 and 210 when constituted in this way. Or a pattern formed of two or more luminescent spots is picturized by the imaging means 111, and by the height operation part 118, since height of said subject is calculated by trigonometry based on said picturized pattern image and a reference image, though it is simple, height of a subject can be measured correctly. When a pattern is made into a luminescent line, continuous height of the direction of a luminescent line can be measured, for example.

[0016]

[Embodiment of the Invention]

Hereafter, an embodiment of the invention is described with reference to drawings. Identical codes are given to the member which is mutually the same or corresponds in each figure, and the duplicate explanation is omitted.

[0017]

Drawing 1 is a typical outline view of the indoor monitoring instrument 1 as a monitoring instrument in space which is a 1st embodiment by this invention. The indoor monitoring instrument 1 is installed in a bathroom. The indoor monitoring instrument 1 is constituted including the three-dimensional sensor 10 which acquires the three-dimensional information in an object domain, and the arithmetic unit 20. The indoor monitoring instrument 1 is constituted so that an object domain may be supervised. A subject breathes. That is, subjects are a person and an animal, for example. In this embodiment, a subject is the person 2. In this embodiment, an object domain is the bathroom 3. The three-dimensional sensor 10 has two or more point of measurement in the object domain, and can measure the height in each point of measurement. In this embodiment, three-dimensional information is coordinates of two or more point of measurement in the bathroom 3, and the height measured on each point. In other words, three-dimensional information is the level distribution in the bathroom 3.

[0018]

The bathroom 3 is the closed space surrounded by the wall surface 6 in the four quarters, and the ceiling 5 is formed up. The wall surface 6 comprises the front wall side 61, the left lateral wall surface 62, the back wall side 63, and the right lateral wall surface 64 (when only calling it below the wall surfaces 61, 62, 63, and 64 and not distinguishing, it is only called the wall surface 6). Furthermore, the bathroom 3 is provided with the following.

Organ bath 4.

Washing place 7.

And the organ bath 4 adjoins the washing place 7, and is installed.

[0019]

The three-dimensional sensor 10 is arranged in the upper part of the bathroom 3. The upper part of the bathroom 3 is the upper part of the ceiling 5 or the wall surface 6 typically. The graphic display shows the case where it arranges to the corner which the ceiling 5 and the wall surface 6 form. The three-dimensional sensor 10 is explained in full detail later. The three-dimensional sensor 10 and the arithmetic unit 20 are electrically connected. Although it is indicated as the three-dimensional sensor 10 and the arithmetic unit 20 as a different body, it may constitute from a graphic display in one. If it does in this way, the indoor monitoring instrument 1 can be miniaturized.

[0020]

With reference to the block diagram of drawing 2, the example of composition of the indoor monitoring instrument 1 is explained. It is connected to the arithmetic unit 20, and the three-dimensional sensor 10 is constituted so that the acquired three-dimensional information may be outputted to the arithmetic unit 20. The arithmetic unit 20 is good to constitute so that three-

dimensional information may be serially acquired from the three-dimensional sensor 10. The arithmetic units 20 are computers, such as a personal computer and a microcomputer, for example. The arithmetic unit 20 has the control section 21 which controls the indoor monitoring instrument 1.

[0021]
The storage parts store 31 is connected to the control section 21. The storage parts store 31 is good to memorize the three-dimensional information acquired more nearly serially than the three-dimensional sensor 10. To the storage parts store 31, the data of the information etc. which were computed is memorizable. The storage parts store 31 has the judging standard storage parts store 32 the judging standard set up for every position in the bathroom 3 mentioned later is remembered to be.

[0022]
The output unit 36 which outputs the result processed with the input device 35 which inputs the information for operating the indoor monitoring instrument 1, and the indoor monitoring instrument 1 is connected to the control section 21. The input device 35 is a touch panel, a keyboard, or a mouse, and the output units 36 are a display and a printer. It may be built although the input device 35 and the output unit 36 are illustrated in this figure as what carries out external to the arithmetic unit 20. The input device 35 of the switch and the output unit 36 which can perform the start and release of surveillance (risk decision) in an object domain, for example is good also as LED as an operation indicator, for example. If it does in this way, the indoor monitoring instrument 1 can be constituted simply. When it constitutes the three-dimensional sensor 10 and the arithmetic unit 20 in one especially, constituting in this way is preferred. By doing in this way, it can be considered as a simpler and small indoor monitoring instrument.

[0023]
The height change primary detecting element 22 as a height change detecting means which detects change of the height in the bathroom 3 in the control section 21 based on the three-dimensional information acquired from the three-dimensional sensor 10, The position detector 23 as a position detecting means which detects the person's 2 position based on change of the height detected by the height change primary detecting element 22, The motion detection part 24 as a motion detecting means which detects a motion of the person 2 based on change of the height detected by the height change primary detecting element 22, Based on the person's 2 position and motion which were detected, it has the risk decision part 25 as a risk decision means by which the person 2 judges whether it is in a dangerous state. The position of the person 2 who detects by the position detector 23 is a position of the field where the person 2 exists, for example, and the position of the person's 2 existence region is a centroid position of the person's 2 existence region typically. Detecting a motion of the person 2 is a concept including detecting that the person 2 does not have a motion. Motions here are breathing, a body motion, and movement, for example. A body motion is a motion of the person's 2 body, for example, is a concept which includes widely a motion of hand and foot besides the motion of standing or sitting down. Hereafter, each composition is explained.

[0024]
Detection of change of the height by the height change primary detecting element 22 detects change of the height in each point of measurement in the bathroom 3 by computing the difference of the three-dimensional information acquired from the three-dimensional sensor 10, and the three-dimensional information saved serially at the storage parts store 31. In other words, change of the height in each point of measurement in the bathroom 3 is detected by taking the difference of the acquired newest three-dimensional information and the three-dimensional information acquired in the past. The three-dimensional information acquired in the past is three-dimensional information typically acquired from the newest three-dimensional information before one (past). Three-dimensional information is acquired from the three-dimensional sensor 10 with a certain time interval in this case. The acquisition interval of three-dimensional information is good to consider it

as about 0.1 to 0.5 second preferably about 0.1 to 3 seconds, for example. Since the influence of random noise can be reduced, for example by acquiring three-dimensional information in shorter time, and performing processing of equalization or filtering, it is effective. An acquisition interval is good also as comparatively long about time, for example, 5 to 20 seconds. In this case, it becomes easy to detect the person's 2 big body motion, for example.

[0025]

The three-dimensional information or height change acquired from the three-dimensional sensor 10 is good also as the moving average deviation of the value which carried out past fixed count acquisition, or was acquired within past fixed time, or period average rates. By doing in this way, the sudden noise by flicker of the daylight inserted from random noise or a window, etc. can be reduced, and incorrect judgment of the erroneous decision of a peak position and a zero cross position (intersection which numerals reverse) can be reduced.

[0026]

The position detector 23 is good to constitute so that the existence region where the person 2 exists may be judged based on height change detected by the height change primary detecting element 22 and the centroid position of said judged existence region may be made into the person's 2 position. By doing in this way, since the person's 2 position is detectable at not a field with area but a point, a slight motion of the person 2 can be detected comparatively sensitively.

[0027]

The judgment of an existence region is a point which is in the predetermined range from this attention point, for example paying attention to height change of the arbitrary point of measurement if height change is beyond a threshold, Height change is beyond a threshold, the number of the point of measurement as a focused position where the direction of change is the same is calculated, and if that number is more than a predetermined value, it will be considered that this range is an existence region.

[0028]

The position detector 23 is a field including the judged existence region, may compute the field where only the predetermined range expanded the existence region, may give priority to the expanded field, and it may constitute it so that the person's 2 position may be detected. In this embodiment, the acquisition interval of the three-dimensional information by the three-dimensional sensor 10, Since it is enough set up for a short time as compared with the motion of the person 2, also when the person 2 does not move greatly between this acquisition interval and then the person's 2 position is detected, the person 2 is considered to exist in the almost same field that position [the field] or adjoined. For this reason, the method of giving priority to the field where only the predetermined range expanded the existence region, and detecting the person's 2 position is effective. By doing in this way, since a possibility that the person 2 exists gives priority to a high field and the person's 2 position is detected, the person's 2 searching time can be shortened and improvement in the speed of processing can be attained.

[0029]

The motion detection part 24 detects a motion of the person 2 based on change of the height detected by the height change primary detecting element 22, as mentioned above. Based on change of the height detected by the height change primary detecting element 22, the motion detection part 24 is constituted so that the person's 2 breathing may be detected.

[0030]

Detection of breathing by the motion detection part 24 sets the threshold of a predetermined maximum minimum to [which was detected by the height change primary detecting element 22 / both or either one of] the amplitude of the periodic change of height change or a cycle (frequency), judges whether it is breathing as compared with this threshold, and detects breathing. The threshold of the maximum minimum of a cycle is good to set the range which contains the cycle of breathing of a person, for example, for example, a minimum, as per minute 5 cycles, and to set a maximum as

per minute 60 cycles. By the way, although a grown-up breathing rate is in about per minute 5 to 30 times of ranges, in the case of a small child, there is a tendency for a breathing rate to increase further. The threshold of the maximum minimum of amplitude is good similarly to set it as the value which is equivalent to 1 mm in the range which contains the amplitude of breathing of a person, for example, for example, a minimum, and is equivalent to height change of about 20 mm in a maximum. Thereby, the person's 2 detected breathing forms a waveform pattern.
Drawing 3 is a figure showing the example of the waveform pattern of breathing.
[0031]
the motion detection part 24 is big to the person 2, if detected height change is beyond a predetermined value -- it moved, namely, the body motion occurred -- it is good to constitute so that it may judge. A predetermined value is preferably set as not less than 20 mm not less than 10 mm, for example. It is made to set up not lap with the range of the below-mentioned breathing. It may be made to judge with there having been a motion which is different whenever it carries out multidata input of the predetermined value and exceeds a constant value everywhere which was set up. By doing in this way, even if it is a body motion, a small body motion and a big body motion of standing or sitting down to which an arm is moved can be distinguished and judged, for example. That is, a motion of the person 2 can be judged more finely. Since height change is far changed sharply compared with the case where only breathing is detected from height change, detection of the person's 2 body motion is easily detectable. Even when the person 2 does a periodic and small motion like a convulsion, it can be detected from a waveform pattern. In such a case, the person's 2 convulsion is also detectable by comparing with the pattern by saving the waveform pattern of the motion which is twitching further at the storage parts store 31.
[0032]
Based on the average value of the height change in the existence region judged by the position detector 23, the motion detection part 24 may be constituted so that a motion of the person 2 may be detected. If it does in this way, the reliability of detection of the motion by the motion detection part 24 will improve.
[0033]
The motion detection part 24 is constituted so that movement of the person 2 can be detected. Detection of movement shall include detection of the direction of movement, speed, and distance besides detection of the existence of movement. The movement can detect the existence of movement at least by, for example, detecting change of the person's 2 position detected by the position detector 23. For example, the person's 2 movement speed is easily detectable by acquiring the person's 2 position with a certain time interval.
[0034]
The risk decision part 25 judges whether the person 2 is in a dangerous state based on the motion of the person 2 detected by the position and the motion detection part 24 of the person 2 detected by the position detector 23. The risk decision part 25 is constituted so that the judgment of whether to be in a dangerous state may be performed based on the judging standard set up for every position in the bathroom 3. Here, the judging standard set up for every position in the bathroom 3 is set up for every position of the organ bath 4, and position of the washing place 7.
[0035]
The judging standard of a dangerous state is explained. The standard judge that is in a dangerous state, for example in the washing place 7. When the amplitude of a motion of the person 2 becomes small and a motion of the person 2 disappears from the state where the amplitude of a motion of the person 2 is large and where in other words body motions (for example, motion of a hand when washing the back etc.) are detected, suddenly, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is because the person 2 fell or can surmise that it fainted, for example. However, when a motion of the person 2 is lost after movement was detected near the entrance of the bathroom 3 even especially in the washing place

7, it is made not to judge with a dangerous state. This is because the person 2 can judge with having come out of the bathroom 3. When it is such a judging standard, when [with large amplitude of a motion of the person 2] in other words body motions (for example, motion of a hand when washing the back etc.) are detected, for example, it will judge with it not being in a dangerous state (suitably henceforth a safety state). When the person 2 judges with having come out of the bathroom 3, it may constitute so that the surveillance in the bathroom 3 may be stopped, until a motion of the person 2 is again detected in the bathroom 3. Since an erroneous decision can be prevented by detecting a noise etc., for example although the person 2 does not exist in the bathroom 3 if it does in this way, it is reliable.

[0036]

When a motion of the person 2 is suddenly lost in the organ bath 4, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is because the person 2 sank or can surmise that it has fainted, for example. If in other words it is such a judging standard, when the person's 2 breathing will be detected, it will judge with it not being in a dangerous state (suitably henceforth a safety state).

[0037]

The standard of a judgment of the dangerous condition of the person 2 by the risk decision part 25 is good to make it set up in consideration of the following. For example, when breathing is detected and the cycle which a breathing pattern has for a short time is confused. Or since it can surmise that they are cerebrovascular disease, such as heart diseases, such as lung diseases, such as spontaneous pneumothorax and bronchial asthma, and congestive heart failure, or cerebral hemorrhage, for example when the cycle which a breathing pattern has changes rapidly, it sets up judge with it being in a dangerous state. Since it can surmise that the person's 2 breathing stopped when disappearance of a breathing pattern continues, it sets up judge with it being in a dangerous state. And since a situation in which the person 2 is troubled with a certain reason, and is rioting can be guessed when the body motion of the person 2 instead of a breathing pattern occurs frequently for a short time, it sets up judge with it being in a dangerous state.

[0038]

With reference to drawing 4, the example of a normal and unusual breathing pattern is explained. A normal breathing pattern is a periodic pattern as shown in drawing 4 (a). However, the range normal as a breathing rate for 1 minute in the case of an adult is about 10 to 20 times. An unusual breathing pattern is a breathing pattern considered to produce chain stokes (Cheyne-Stokes) breathing, central hyperventilation, ataxic breathing, large breathing of dregs MAURU (Kussmul), etc. when the obstacle has occurred inside of the body physiologically, for example.

[0039]

The breathing pattern of central hyperventilation is shown in drawing 4 (c), and the breathing pattern of ataxic breathing is shown for the breathing pattern of Cheyne-Stokes breathing in drawing 4 (b) at drawing 4 (d), respectively.

Furthermore, the name of a disease or the disease part at the time of being generated by the above-mentioned unusual breathing pattern is shown in drawing 5.

[0040]

The risk decision part 25 is good to distinguish whether the person's 2 breathing pattern belongs to which above-mentioned breathing pattern using the frequency of breathing of each breathing pattern and appearance frequency differing from sounding, and to judge the person's 2 dangerous condition. It is good to save the above breathing patterns at the storage parts store 31. By doing in this way, it can be easily judged by comparing with these patterns whether the person's 2 breathing is normal.

[0041]

Furthermore, it judges with the person 2 doing unusual breathing and the risk decision part 25 being in a dangerous state, when it judges with belonging to the breathing pattern considered that the

person's 2 breathing arises when the obstacle has occurred inside of the body physiologically. The breathing pattern considered to produce in **** which the obstacle has generated inside of the body physiologically is a breathing pattern explained, for example by drawing 4. The person's 2 dangerous condition judged in this way is good to output to the output unit 36 or the alarm equipment 38 by the control section 21 for example. The contents outputted are the name of a disease, a disease organ, a disease part, etc. which are considered when it comes to the person's 2 detected breathing rate (cycle), the frequency of a motion, and the name of an unusual breathing pattern and the cause of the breathing.

[0042]

It returns and explains to drawing 2. When the person 2 is in a dangerous state, the risk decision part 25 is constituted based on a decision result so that an alarm signal may be outputted. An alarm signal is typically outputted to the below-mentioned alarm equipment 38.

[0043]

Here, the example of the alarm signal which the risk decision part 25 outputs is explained. When the state where it has judged with the dangerous state outputs the internal alarm signal as the 1st alarm signal when the 1st carries out prescribed period progress, and the 2nd of a period longer than the 1st prescribed period carries out prescribed period progress, the risk decision part 25 is constituted so that the external alarm signal as the 2nd alarm signal may be outputted. In outputting an external alarm signal, it becomes conditions that the internal alarm signal was outputted within the 2nd prescribed period. The 1st prescribed period and the 2nd prescribed period may be set, for example by time, and may be set with the acquired three-dimensional information number. When it sets by time, the 1st prescribed period is preferably made into about 5 to 10 seconds for 3 to 15 seconds, for example, and the 2nd prescribed period is about 10 to 20 seconds preferably for 10 to 30 seconds, for example. For example, when the 1st prescribed period is carried out, a frame number shows this and the acquisition interval of three-dimensional information is made into per second 1 time for the 2nd prescribed period for 15 seconds for 8 seconds, an internal alarm signal is 8 times and an external alarm signal is 15 times. The risk decision part 25 may be constituted so that the external alarm signal as the 2nd alarm signal may be outputted, when it outputs the internal alarm signal as the 1st alarm signal when there is the number of times judged to be a dangerous state among the predetermined number of times in the 1st number of times, and there is the 2nd number of many number of times from the 1st number of times. When the predetermined number of times considers it, for example as 15 to 25 times, the 2nd number of times is [the 1st number of times] good to use ten to about 20 about 5 to 10 times.

[0044]

An internal alarm signal is a thing for checking the existence of abnormalities, for example comparatively slight alarm 2, for example, person, or demanding cautions from him. When the risk decision part 25 outputs an internal alarm signal, the indoor monitoring instrument 1 is constituted from the loudspeaker which is not illustrated [with which the bathroom 3 was equipped] by the alarm equipment 38, for example so that voice response of the message of "whether it is OK" may be carried out. An external alarm signal is a serious alarm signal as compared with an internal alarm signal. Hereafter, when not distinguishing an internal alarm signal and an external alarm signal in particular, it is only called an alarm signal.

[0045]

The arithmetic unit 20 is provided with the alarm equipment 38 which emits an alarm. The alarm equipment 38 comprises inputting an alarm signal so that an alarm may be emitted. The alarm equipment 38 is good to constitute so that an alarm may be emitted, when the risk decision part 25 judges that the person 2 is in a dangerous state, for example, or when abnormalities, such as failure, occur in the indoor monitoring instrument 1. The alarm equipment 38 is constituted so that the alarm of a different kind may be emitted according to the inputted alarm signal. An alarm which is specifically different for every kind of inputted alarm signal, for example is set up. In other words,

the alarm equipment 38 is with the inputted internal alarm signal and an external alarm signal, and is set up emit an alarm different, respectively. Thereby, the user (administrator) of a device can recognize easily that the person 2 is in a dangerous state, for example with the emitted alarm, for example. Since it receives unusually and can respond promptly by doing in this way, reliability can be improved. The arithmetic unit 20 is good to constitute via the interface 37, so that generating of an alarm may be notified outside, when the alarm equipment 38 operates. Although the alarm equipment 38 is illustrated as external, it is good also as built-in in this figure.
[0046]
It has the interface 37 for the arithmetic unit 20 to communicate with the exterior. The interface 37 is constituted so that it can report outside, when an alarm is emitted, for example by the alarm equipment 38. A report is based on the strength of the light which includes a sound, a character, a sign, and interior illumination, for example, or vibration. The interface 37 is provided with the function connected to communication lines, such as a general telephone line, an ISDN circuit, a PHS circuit, or a cellular-phone circuit. That is, when the indoor monitoring instrument 1 is installed in the home, for example, distant medical facilities, such as a place, for example, a hospital etc., can be notified by using the above-mentioned communication line. even if it was a place which is distant from the place in which the indoor monitoring instrument 1 was installed, for example by doing in this way, the alarm was emitted by using the above-mentioned communication line -- since it can report easily, it is effective. The control section 21 is provided with a voice response function, and it may be made to notify the condition of an alarm or the person 2 to a third party with a sound via the interface 37.

[0047]
according to the indoor monitoring instrument 1 of a 1st above embodiment, detect the person's 2 position, and a motion and the person 2 breaks down also from a bathroom -- etc. -- a dangerous state can be judged certainly and promptly. Since the sinking condition in an organ bath is detectable, early detection is possible. When the person 2 is in a washing place, even if it detects ****, when the appeal into a bathroom is performed slowly, unnecessary appeal and report are reduced and the person 2 is in an organ bath, By the person's 2 room, it is possible to choose correspondence and it can be compatible in use of a comfortable bathroom, and emergency correspondence by quiet, such as giving priority to a quick report.
[0048]
Although the case where an indoor monitoring instrument was applied to the bathroom 3 was explained as an example above, application of an indoor monitoring instrument may not be restricted above, for example, may be the interior of a room of a toilet and an ordinary home, a bedroom, or a sickroom of a hospital. Hereafter, the example in the case of installing an indoor monitoring instrument in a toilet is explained.
[0049]
Drawing 6 is a typical outline view of the indoor monitoring instrument 201 as a monitoring instrument in space which is a 2nd embodiment by this invention. The indoor monitoring instrument 201 is the same composition as the indoor monitoring instrument 1 mentioned above. In this embodiment, an object domain is the toilet 203.
[0050]
The toilet 203 is the closed space surrounded by the wall surface in the four quarters like the bathroom 3. The toilet bowl 204 approaches the wall surface side which meets the entrance 206, and the toilet 203 is arranged. In other words, the toilet bowl 204 is installed in the inner part of the toilet 203. The three-dimensional sensor 10 is arranged in the upper part of the toilet 203. The upper part of the toilet 203 is the upper part of a ceiling or a wall surface typically. The graphic display shows the case where it arranges to the corner which a ceiling and a wall surface form.
[0051]
Although the risk decision part 25 mentioned above in drawing 2 is constituted similarly, the judging

standard set up for every position is [the part] good here to set to every [of the about 204 toilet bowl near position 204' and near the entrance] position 207'.

[0052]

Here, the judging standard of the dangerous state in the case of the indoor monitoring instrument 201 is explained. The standard judge that is in a dangerous state, for example in position 207' near the entrance. When the amplitude of a motion of the state where in other words body motions (for example, motion etc. which moves to the toilet bowl 204 from the entrance 206) are detected to the person 2 with large amplitude of a motion of the person 2 becomes small, When a motion of the person 2 is lost suddenly, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is because the person 2 fell or can surmise that it fainted the same with having mentioned above with the indoor monitoring instrument 1, for example. When a motion of the person 2 is similarly lost after movement in the entrance 206 was detected, it is made not to judge with a dangerous state. This is because the person 2 can judge with having come out of the toilet 203.

[0053]

In about 204-toilet bowl position 204', when a motion of the person 2 is lost suddenly, it is good to be based on the time of the state where there is no motion carrying out predetermined time continuation. This is because it can surmise that the person 2 has fainted, for example. If in other words it is such a judging standard, when the person's 2 breathing will be detected, it will judge with it not being in a dangerous state. Namely, when the person 2 has done his business, for example (when sitting on the toilet seat of the toilet bowl 204, or while standing in front of the toilet bowl 204). Fundamentally, like the case of the above-mentioned organ bath 4, the person 2 is that (quiet state) which does not carry out a body motion, and if breathing is detected even if there is no big motion, he can guess a safety state. About the judgment of breathing, since it is the same as that of the indoor monitoring instrument 1, explanation is omitted.

[0054]

The above indoor monitoring instruments 201 of a 2nd embodiment, What the person's 2 size can advance into the toilet as an object domain, and a series of motions whether it is in the thing state (the seat which stands is and it has broken down from which position) whose person 2 is how or the person 2 is moving, and whether it left can be followed.

[0055]

The three-dimensional sensor 10 is explained here. The three-dimensional sensor 10 can acquire the three-dimensional information in an object domain by non-contact typically. Hereafter, this embodiment explains FG sensor used as a three-dimensional sensor.

[0056]

With reference to the notional perspective view of drawing 7, the FG (fiber grating) sensor 101 used as the three-dimensional sensor 10 suitable for the indoor monitoring instruments 1 and 201 of this embodiment is explained. The FG sensor 101 can acquire the three-dimensional information on the subject (person 2) which exists in an object domain. That is, it is constituted so that distribution of the height of a subject can be measured. Here, the flat surface 102 and a subject are explained for the inside of an object domain as the object 103 for explanation.

[0057]

The FG sensor 101 is provided with the following.

The luminescent spot projection device 110 as a projection means which projects two or more luminescent spots on an object domain.

The imaging device 111 as an imaging means which picturizes the pattern 110a formed by projection of the luminescent spot projection device 110.

The patterns 110a are two or more luminescent spots typically arranged in the shape of a tetragonal lattice. The shape of a luminescent spot is an approximate circle form containing an ellipse form.

[0058]

The object 103 in a figure is laid on the flat surface 102. The rectangular coordinate system XYZ is taken and the object 103 is put on the 1st quadrant of an XY coordinate system so that XY axis may be placed in the flat surface 102. On the other hand, above the flat surface 102, the luminescent spot projection device 110 and the imaging device 111 are arranged on the Z-axis in a figure. The imaging device 111 picturizes the object 103 on which the pattern 110a was projected by the luminescent spot projection device 110.

[0059]

The imaging device 111 is provided with the following.

Image formation lens 111a.

Image sensor 115.

The image sensor 115 is a CCD camera typically. Typically, the image formation lens 111a of the imaging device 111 is arranged so that the optic axis may be in agreement with the Z-axis. And the image formation lens 111a carries out image formation of the image of the pattern 110a on the flat surface 102 or the object 103 to image formation face 115' (image plain) of the image sensor 115. Image formation face 115' is a field which intersects perpendicularly with the Z-axis typically. xy rectangular coordinate system is taken in image formation face 115', and the Z-axis passes along the starting point of xy coordinate system. At the image formation lens 111a and the equal distance, the luminescent spot projection device 110 is arranged from the flat surface 2 at the place which only the distance d (base length d) separated from the image formation lens 111a to the negative direction of the Y-axis. The pattern 110a which two or more luminescent spots 110b form with the luminescent spot projection device 110 is projected on the object 103 and the flat surface 102. y shaft orientations are also base line directions of the trigonometry used for the operation of the height later mentioned by drawing 9.

[0060]

The image sensor 115 is a CCD image sensor typically. The element of CMOS structure other than CCD is announced briskly these days, and, naturally it is usable also in them. There are some which were especially provided with the function of inter-frame difference ** or binarization into these at the element itself, and use of these elements is preferred.

[0061]

The control device 114 is connected to the image sensor 115. In other words, the imaging device 111 is connected to the control device 114. The control device 114 controls the FG sensor 101 whole. Although the control device 114 is typically installed in the imaging device 111 and a different body, it may be constituted in one. The miniaturization of a device can be attained if it does in this way. The control devices 114 are computers, such as a personal computer, typically. In the control device 114, the image processing device 117 which acquires the image of the pattern picturized by the imaging device 111 is incorporated.

[0062]

Furthermore in the control device 114, the height operation part 118 which calculates the height of the object 103 as a subject by trigonometry based on the pattern image and reference image which were picturized by the imaging device 111 is incorporated. Here, although a reference image and a pattern image are images picturized, for example by the imaging device 111, they are a concept also including the information on the position on each image sensor 115 (or image formation face 115') of a reference image and a pattern image. That is, a reference image and a pattern image are images of the pattern 110a formed by projection of the luminescent spot projection device 110. Here a reference image is an image of the pattern 110a in case the object 103 does not exist in the flat surface 102, and a pattern image is an image of the pattern 110a when the object 103 exists in the flat surface 102. That is, a reference image is an image which shows the reference position of each luminescent spot 110b of the pattern 110a. A reference image is good to save beforehand at the image processing device 117. Here, a reference image is not as what is called an image, for example, and is good to make it save in the form of the information on positions about the position of each

luminescent spot 110b, such as coordinates. If it does in this way, when detecting the movement magnitude of a luminescent spot based on the pattern image and reference image which are mentioned later, since what is necessary is just to compare coordinates and the direction of a luminescent spot, for example, processing becomes simple.

[0063]

The imaging device 111 is good to have the filter 111b which dims the light of wavelength other than the periphery of the wavelength of the laser luminous flux L1 generated by the below-mentioned light flux generating part 105 (refer to drawing 10). The filters 111b are light filters, such as an interference filter, and are typically good to arrange on the optic axis of the image formation lens 111a. If it does in this way, since the luminous intensity of the pattern 110a projected from the luminescent spot projection device 110 among the lights which receive light to the image sensor 115 goes up relatively, the imaging device 111 can reduce the influence by disturbance light. The laser luminous flux L1 generated by the light flux generating part 105 is the light flux of infrared light laser typically. It may irradiate with the laser beam L1 continuously, and may irradiate with it intermittently. In glaring intermittently, the image pick-up by the imaging device 111 is synchronized with the timing of an exposure, and it is made to perform it.

[0064]

The FG sensor 101 is good to constitute so that it may become irregular, in order to distinguish from disturbance light, when picturizing the pattern 110a with the imaging device 111. Abnormal conditions are the operation which repeats periodically the luminescence (exposure) stop of the laser luminous flux L1 by the light flux generating part 105, and performs it, for example. In this case, the luminescence stop of the laser luminous flux L1 may carry out the luminescence stop of the light source, for example, and may be made to carry out a luminescence stop by rotating a gobo and a slit. In this case, the influence of disturbance light can be remarkably reduced by taking out the light-receiving signal in sync with these abnormal conditions. It may be made for abnormal conditions to also change the output of the laser luminous flux L1 by the strength of disturbance light furthermore in addition to ****. It may be made for the image processing device 117 to generate the signal which deducted the light-receiving signal when not irradiating with the laser luminous flux L1 from the light-receiving signal when irradiating with the laser luminous flux L1. Thereby, the influence of disturbance light can be reduced. In order to secure reliability, the FG sensor 101 may constitute modulation operation so that the output signal of a multiple-times deed and its average may be used as acquired data, i.e., a pattern image.

[0065]

Here, an operation of the FG sensor 101 is explained with reference to drawing 7. First, the concept of measurement of the height of the object 103 is explained. In the portion in which the object 103 exists, the pattern 110a projected on the flat surface 102 by the luminescent spot projection device 110 is interrupted by the object 103, and does not arrive at the flat surface 102. If the object 103 exists here, the luminescent spot 110b on which it should be projected by the point 102a on the flat surface 102 will be projected by the point 103a on the object 103. From the place from which the image formation lens 111a and the luminescent spot projection device 110 have separated only the distance d (base length d) again when the luminescent spot 110b moved to the point 103a from the point 102a, In image formation face 115' up, the place which should be carried out image formation carries out image formation to point 102a' (x, y) at point 103a' (x, y+delta). That is, when the time of the object 103 not existing and the object 103 exist, the image of the luminescent spot 110b will move only the distance delta to y shaft orientations.

[0066]

As this shows drawing 8, for example, only delta will move the image of the luminescent spot 110b which carried out image formation to y shaft orientations with the object 103 with height at image formation face 115' of the image sensor 115.

[0067]

The position of the point 103a on the object 103 can specify the FG sensor 101 in three dimensions by measuring this delta. That is, the height of the point 103a is known. Thus, if a certain point does not exist [the object 103], when measuring a difference with the actual image formation position on image formation face 115 'the point which should be turned image formation up and the image formation face 115', if it is distributed and the height of the object 103 puts in another way, three-dimensional shape is measurable. Or the three-dimensional coordinates of the object 103 are measurable. If the pitch of the pattern 110a, i.e., the pitch of the luminescent spot 110b, is made fine to such an extent that the correspondence relation of the luminescent spot 110b does not become unknown, distribution of the height of the object 103 can be measured so in detail.

[0068]

Here, the operation of the height by the height operation part 118 is explained. The height operation part 118 reads a pattern image and a reference image, and measures the movement magnitude delta of the image of the luminescent spot 110b. Measurement of the movement magnitude delta creates the difference image of a pattern image and a reference image first. And the movement magnitude delta of the position of the image of a luminescent spot corresponding from this difference image is measured. The movement magnitude delta is calculated by, for example, calculating the pixel number (what pixel moved?) which the position of the image of the luminescent spot 110b moved. Although explained by the case where a difference image is created, the above saves the reference image in the form of the information on the position of each luminescent spot 110b, is comparing the information on the position of each luminescent spot 110b of a pattern image with the information on the position of the luminescent spot 110b of a reference image, and may measure the movement magnitude delta. If it does in this way, since it is not necessary to generate a difference image, processing can be simplified. The height operation part 118 calculates the height of the object 3 by trigonometry based on the movement magnitude delta. With reference to drawing 9, calculation of the height of the object 103 by trigonometry is explained.

[0069]

Drawing 9 is the imaging device 111, the luminescent spot projection device 110, the object 103, and the side view that looked at the relation with the flat surface 102 to the X axial direction (refer to drawing 7). Here, it explains by the case where the height of the object 103 is Z1. The center (the center of the source of pattern light) of the luminescent spot projection device 110, and the center of the image formation lens 111a, Detach only the distance d in parallel with the flat surface 102, and it is arranged, and the distance to image formation face 115' (image sensor 115) from the image formation lens 111a l (El) (almost equal to the focus of the image formation lens 111a), h and the height from the flat surface 102 of the point 103a of the object 103 of the distance from the image formation lens 111a to the flat surface 102 are Z1. the result by which the object 103 was placed on the flat surface 102 -- the image formation face 115 -- suppose that it moved to 'the point 103a that upper point 102a' left only delta'.

[0070]

If the point that the line which connects the center and the point 103a of the image formation lens 111a in a figure intersects the flat surface 102 is made into 102a″, the distance D of the point 102a and point 102a.″ If triangle 103a'-102a'-111a and triangle 102a″-102a-111a are observed, it will be D=delta-h/l, and if triangle 111a-110-103a and triangle 102a″-102a-103a are observed, it will be D=(d-Z1)/(h-Z1). If Z1 is calculated from both this type, it will become like a following formula.

$Z1=(h^2 \text{anddelta}) /(d\text{-}l+h\text{-delta})$ ...... (1)

As mentioned above, the height of the object 103 is computable.

[0071]

The past fixed count operation was done or the height of the object 103 calculated by the height operation part 118 is good also as the moving average deviation of the height calculated within past fixed time, or period average rates. By doing in this way, the sudden noise by flicker of the daylight inserted from random noise or a window, etc. can be reduced, and the reliability of the height of the

calculated object 103 improves.
[0072]
As mentioned above, the FG sensor 101 picturizes the pattern 110a formed in the object domain by projection of the luminescent spot projection device 110 with the imaging device 111, Since the height of a subject is calculated by the height operation part 118 by trigonometry based on this pattern image and reference image that were picturized, the height of a subject is measurable. Since the FG sensor 101 can measure the height of a subject in respect of the plurality in an object domain, it can measure distribution of the height of a subject. The temporal change of level distribution is also measurable by measuring distribution of this height, for example with a certain time interval.
[0073]
With reference to the typical perspective view of drawing 10, the luminescent spot projection device 110 suitable for the FG sensor 101 is explained. The luminescent spot projection device 110 is provided with the following.
The light flux generating part 105 as a luminous flux generating means which generates coherent light flux.
Fiber grating 120 (only henceforth the grating 120).
Coherent light flux is infrared light laser typically. The light flux generating part 105 is constituted so that a parallel pencil may be generated. The light flux generating part 105 is a semiconductor laser device typically constituted including an unillustrated collimating lens, and the parallel pencil generated is the laser luminous flux L1. And the section of the laser luminous flux L1 is approximate circle-shaped light flux. If substantially parallel to a parallel pencil, it is good and light flux near in parallel is also included here.
[0074]
Here, the grating 120 is explained by the case where it is arranged in parallel (it is right-angled to the Z-axis) with the flat surface 102. The laser beam L1 is entered in Z shaft orientations at the grating 120. Then, the laser beam L1 serves as a divergent wave, with each optical fiber 121, after it condenses in a field with the lens effect, spreads, and goes and interferes, and the pattern 110a is projected on the flat surface 102 which is a surface of projection. Arranging the grating 120 in parallel with the flat surface 102 is arranging so that the flat surface containing the axis of each optical fiber 121 of FG element 122 which constitutes the grating 120, and the flat surface 102 may become parallel.
[0075]
The grating 120 is constituted including two FG elements 122. In this embodiment, the flat surface of each FG element 122 is mutually parallel. Hereafter, the flat surface of each FG element 122 is called element flat surface. In this embodiment, the axis of the optical fiber 121 of two FG elements 122 lies at right angles mostly mutually.
[0076]
As for FG element 122, several 10 - about 100 numbers put in order and constitute in parallel the optical fiber 121 whose diameters are several 10 microns and about 10 mm in length in a sheet shaped, for example. Two FG elements 122 may contact, may be arranged, and may vacate and arrange distance to the normal line direction of each element flat surface. In this case, mutual distance of two FG elements 122 is made into the grade by which projection of the pattern 110a is not hindered. Typically, the laser luminous flux L1 is vertically entered to the element flat surface of the grating 110.
[0077]
As mentioned above, the luminescent spot projection device 110 can miniaturize an optical case, without needing a complicated optical system, since the grating 120 constituted including two FG elements 122 serves as an optical system. Furthermore, the luminescent spot projection device 110 is using the grating 120, is simple composition and can be projected on the flat surface 102 by using

two or more luminescent spots 110b as the pattern 110a.
[0078]
Although the pattern was explained as two or more luminescent spots above, it is good also as two or more luminescent lines. That is, it may be made to measure the height of a subject using an optical cutting method. In this case, it has the luminescent line projection device 210 as a projection means which projects a luminescent line on an object domain instead of the luminescent spot projection device 110. Although the number of the luminescent lines projected with the luminescent line projection device 210 is plurality typically, it may be one. Hereafter, in two or more case, a luminescent line is explained. Hereafter, the thing at the time of using an optical cutting method for the FG sensor 101 is explained as FG sensor 101'.
[0079]
FG sensor 101' is explained with reference to the typical key map of drawing 11. The luminescent line projection device 210 projects two or more luminescent lines 210b on the flat surface 102 in parallel. The imaging device 111 picturizes the object 103 and the flat surface 102 where the pattern 210a was projected by the luminescent line projection device 210. Two or more luminescent lines 210b are projected at equal intervals. Two or more luminescent lines 210b form the pattern 210a. The direction of the luminescent line 210b and the base line direction of trigonometry are almost vertical. That is, the direction of the luminescent line 210b is vertical to the y-axis. Here, it may be one although the luminescent line is made into two or more. In this case, FG sensor 101' can be constituted still more simply.
[0080]
Here, the concept of the height measurement of the object 103 using an optical cutting method is explained. In the portion in which the object 103 exists, the pattern 210a projected on the flat surface 102 by the luminescent line projection device 210 is interrupted by the object 103, and does not arrive at the flat surface 102. If the object 103 does not exist here, the luminescent line on which it should be projected by the point 102a on the flat surface 102 is projected by the point 103a on the object 103. the luminescent line moved to the point 103a from the point 102a -- image formation face 115from place from which image formation lens 111a and luminescent line projection device 210 have separated only distance d (base length d)' -- in a top, the place which should be carried out image formation carries out image formation to point 102a' (x, y) at point 103a' (x, y+delta). That is, when the time of the object 103 not existing and the object 103 exist, a luminescent spot will move only the distance delta to y shaft orientations.
[0081]
As this shows drawing 12, for example, only delta will move the image of the luminescent line 210b which carried out image formation to y shaft orientations with the object 103 with height at image formation face 115' of the image sensor 115. The position of the point 103a on the object 103 can specify in three dimensions by measuring this delta like the FG sensor 101. That is, the height of the point 103a is known. If the pitch of the pattern 210a, i.e., the pitch of the luminescent line 210b, is made fine to such an extent that the correspondence relation of the luminescent line 210b does not become unknown, distribution of the height of the object 103 can be measured so in detail. Calculation of the height by the height operation part 118 is the same as that of explanation of drawing 9.
[0082]
As mentioned above, FG sensor 101' makes a pattern two or more luminescent lines, compared with the case where a pattern is made into a luminescent spot, it is measuring movement of a luminescent line, and can measure movement of the arbitrary points of a luminescent line, and can recognize the continuous shape of the direction of a luminescent line. In other words, the resolution of measurement of the X axial direction in a figure can be improved.
[0083]
With reference to the typical perspective view of drawing 13, the luminescent line projection device

210 suitable for FG sensor 101' is explained. The luminescent line projection device 210 is provided with the following.
The light flux generating part 105 mentioned above in drawing 10.
Fiber grating 220 (only henceforth the grating 220).

[0084]
Here, the grating 220 is explained by the case where it is arranged in parallel (it is right-angled to the Z-axis) with the flat surface 102. The laser beam L1 is entered in Z shaft orientations at the grating 220. Then, the laser beam L1 serves as a divergent wave, with each optical fiber, after it condenses in a field with the lens effect, spreads, and goes and interferes, and the pattern 210a is projected on the flat surface 102 which is a surface of projection. Arranging the grating 220 in parallel with the flat surface 102 is arranging so that the flat surface containing the axis of each optical fiber 221 of 1st FG element 222 that constitutes the grating 220, and the flat surface 102 may become parallel, as later mentioned by drawing 14.
[0085]
The grating 220 is explained with reference to the mimetic diagram of drawing 14. (a) is a perspective view and (b) is a front view. The 1st fiber grating element 222 (henceforth 1st FG element 222) that turned the axis of each optical fiber 221 in the 1st direction v1 and as for which the grating 220 put two or more optical fibers 221 in order in parallel and planate, The 2nd fiber grating element 223 (henceforth 2nd FG element 223) that put two or more optical fibers 221 in order in parallel and planate towards the 2nd direction v2 that is different from the 1st direction v1 in the axis of each optical fiber 221, It is constituted including the 3rd fiber grating element 224 (henceforth 3rd FG element 224) that put two or more optical fibers 221 in order in parallel and planate towards the 3rd direction v3 that is different from the 1st direction v1 and the 2nd direction v2 in the axis of each optical fiber 221. In this embodiment, the flat surface of each FG elements 222, 223, and 224 is mutually parallel. Here, in order to identify each FG element, it is called the 1st FG element, the 2nd FG element, and the 3rd FG element. According to this embodiment, it has piled up in order of the 1st FG element, the 2nd FG element, and the 3rd FG element. however, it may pile up in order of other order, for example, the 1st FG element, inside, the 3rd FG element, and the 2nd FG element. Hereafter, the flat surface of each FG elements 222, 223, and 224 is called element flat surface.
[0086]
1st FG element 222, 2nd FG element 223, and 3rd FG element 224 are the same as FG element 122 mentioned above. In a graphic display, although each FG elements 222, 223, and 224 show the case where it contacts and arranges, they may vacate and arrange distance to the normal line direction of an element flat surface, respectively. In this case, mutual distance of each FG elements 222, 223, and 224 is made into the grade by which projection of the pattern 210a is not hindered.
[0087]
You make it pile up 1st FG element 222, 2nd FG element 223, and each other's 3rd FG element 224, and they constitute the grating 220. in addition -- being mentioned here -- it piles each other up -- making -- it is piled up so that each element flat surface of each FG elements 222, 223, and 224 may become almost parallel. In other words, by this embodiment, the grating 220 is laid on top of the order of 1st FG element 222, 2nd FG element 223, and 3rd FG element 224 so that each element flat surface may become parallel. The grating 220 is constituted so that the laser luminous flux L1 generated by the light flux generating part 105 may be made to penetrate. The laser luminous flux L1 is made to penetrate here in order of 1st FG element 222, 2nd FG element 223, and 3rd FG element 224. Typically, the laser luminous flux L1 is vertically entered to the element flat surface of the grating 220 (1st FG element 222).
[0088]
As shown in drawing 14 (b), in this embodiment, the 1st direction v1 and 2nd direction v2 lie at right

angles mostly. The 3rd direction v3 makes it rotate from the 1st direction v1 in the field where only the predetermined angle theta is parallel to an element flat surface, and 3rd FG element 224 is piled up. The predetermined angle theta is later mentioned with reference to drawing 15.

[0089]

Here, the predetermined angle theta is explained with reference to drawing 15. The change of a luminescent spot by giving the predetermined angle theta first is explained. (a) explains by the case where the predetermined angle theta is theta 1, as shown in (b). (a) is a figure showing a part of pattern 210a' projected when this side is made to penetrate the laser luminous flux L1 from the ****** side of (b). By graphic display, about 10 degrees has shown theta 1 as reference. First, the luminescent spots 251, 252, 253, 254, and 255 which are a part of pattern 210a' projected when the predetermined angle theta is 0 degree are observed. And if the predetermined angle theta 1 is given to 3rd FG element 224, it will diffract to the straight line 251a which is a generation direction of each luminescent spot in the direction of straight-line 251a' which makes the angle theta 1, respectively, and each above-mentioned luminescent spot will project a new luminescent spot. If it furthermore explains and the luminescent spot 251 will be observed, it will diffract in the direction of straight-line 251a', and the luminescent spot 251 will project new luminescent spot 251' on it.

[0090]

Thereby, since the diffraction direction of a luminescent spot changes with the predetermined angle theta, by some theta, it is parallel and two or more luminescent line sequences (only henceforth two or more luminescent lines) arranged at equal intervals and a dense luminescent spot array can be projected, for example. In other words, two or more luminescent lines can be easily projected by adjusting the predetermined angle theta to 3rd FG element 224.

[0091]

With reference to the mimetic diagram of drawing 16, the predetermined angle theta is adjusted and the example in the case of making a pattern into two or more luminescent lines is explained. A luminescent line is formed because two or more luminescent spots gather linearly. an FG element -- low -- diffraction efficiency is uniformly near over the high order diffracted light from the next, and since the luminescent line is formed because two or more luminescent spots gather, even if the luminosity of the center section of the luminescent line says in the direction of an end of a luminescent line from a center section, it cannot change easily. That is, a luminescent line with uniform luminosity can be projected. When using two or more luminescent lines, the predetermined angle theta is preferably good most preferably to consider [0.1-10-degree / 1-8-degree] it as about 5 degrees. It becomes two or more luminescent lines same also in the case of theta= 85 degrees. However, the pattern projected turns into a pattern made to rotate (b) of 90 degrees in this case.

[0092]

As mentioned above, the luminescent line projection device 210 is making 1st FG element 222, 2nd FG element 223, and 3rd FG element 224 penetrate the laser luminous flux L1, and since the pattern 210a of two or more luminescent lines can be projected, it can be constituted simply. The luminescent line projection device 210 can miniaturize an optical case, without needing a complicated optical system, since the grating 220 constituted including 1st piled-up FG element 222, 2nd FG element 223, and 3rd FG element 224 serves as an optical system. Since it is constituted in this way, it can project on the flat surface 102 by using two or more luminescent lines as the pattern 210a. Since a luminescent line is formed by set of a luminescent spot, two or more luminescent lines with uniform luminosity can be projected. For this reason, it is predominant when measuring movement of a luminescent line like this embodiment.

[0093]

For example, it explained in the case of the luminescent line projection device 210 mentioned above, but it is not restricted to this, a luminescent line projection device may be constituted using a cylindrical lens, a slit, etc. so that two or more luminescent lines may be projected as the pattern

210a.
[0094]
The luminescent line projection device 310 is shown in drawing 17 as another example of a luminescent line projection device. The luminescent line projection device 310 has the optical element 311 formed with optical glass. The convex 311a section of an approximately triangle is formed in the incidence side of light flux for a section, and, as for the optical element 311, the cylinder side 311b is further formed in the incidence side tip part of the light flux of the heights 311a. The optical element 311 is a PAUERU lens currently typically indicated by US4826299. In such a cylinder side 311b of the optical element 311, a luminescent line can be projected on an object domain by light flux generating part 105' by entering laser-luminous-flux L1' of a path smaller than the curvature radius of this cylinder side 311b. Two or more luminescent lines can be projected on the object domain side of the optical element 311 by arranging a diffraction element, for example, the FG element mentioned above. The luminescent line projection device 310 can project two or more luminescent lines with uniform luminosity by using such an optical element 311.
[0095]
It may be made for FG sensor 101' to picturize two or more pattern images projected on the position which is fully a high speed compared with a motion of a subject, and scans a luminescent line to y shaft orientations in a figure, and from which a luminescent line differs in an object domain in the object domain, as shown in the mimetic diagram of drawing 18. In this case, it is considered as luminescent line projection device 210' which can scan the luminescent line which projected the luminescent line generating means to the specific direction of an object domain. It is good also as a pattern image which is an image of the above-mentioned pattern 210a (refer to drawing 11) by the combination of two or more pattern images picturized in this way in this case. In other words, as shown in (b), the same pattern image as the pattern image of the object domain where it was projected, two or more above-mentioned luminescent lines 210a, i.e., pattern, may be generated by combining the pattern image of the luminescent line projected on a different position. If it furthermore explains, it will be generating the pattern image of the object domain where two or more luminescent lines were projected, for example like a graphic display combining the pattern image acquired to the time t1, t2, t3, and t4. That is, while the luminescent line is scanning the inside of an object domain, the number of times which acquired the pattern image turns into a number of the image of the luminescent line on the pattern image put together. There is one luminescent line to scan typically.
[0096]
Here, with reference to the typical outline view of drawing 19, the example of installation of the FG sensor 101 in the case of the indoor monitoring instrument 1 is explained. The luminescent spot projection device 110 and the imaging device 111 are arranged to the top both ends of the wall surface 64 of the bathroom 3. In the graphic display, the imaging device 111 is arranged at the person's 2 end by which the luminescent spot projection device 110 has been about arranged for the luminescent spot projection device 110 at the end by the side of the head upper part, and the end by the side of reverse. As shown in (b), the luminescent spot projection device 110 has projected the pattern 110a on the organ bath 4 of the bathroom 3, and the washing place 7. It is set up and the field angle of the imaging device 111 is so that the bathroom 3 whole can be picturized. The control device 114 may also be incorporated in the control section 21 explained by drawing 2. The composition of the indoor monitoring instrument 1 can be simplified by doing in this way.
[0097]
Typically, the luminescent spot projection device 110 leans and installs the optic axis (projecting direction of laser luminous flux) to the perpendicular direction of an object domain like a graphic display. By doing in this way, the pattern 110a can be projected broadly easily. It can perform easily detaching and installing the distance of the imaging device 111 and the luminescent spot projection device 110, for example. In other words, it can perform taking long base length easily. The imaging

device 111 leans and installs an optic axis to the perpendicular direction of an object domain similarly. By doing in this way, the bathroom 3 whole can be picturized easily. It can perform taking long base length easily. Here, as mentioned above, the luminescent spot projection device 110 and the imaging device 111 may be about installed in parallel to said perpendicular direction, although each optic axis is leaned and installed to the perpendicular direction of the level surface. Each optic axis of each other may be turned in parallel, and may be installed.
[0098]
The imaging device 111 and the luminescent spot projection device 110 are good to detach and install distance to some extent. By doing in this way, since the distance d (base length d) mentioned above in drawing 7 becomes long, change can be detected sensitively. Here, long base length is taken by arranging to the top both ends of the wall surface 64. It may be short although taking for a long time is preferred as for base length. However, as mentioned above, although it becomes difficult to detect the small movement toward breathing etc. in this case, if the person's 2 centroid position is detected, the small detection which moves (breathing) is also possible. Here, although it attached FG sensor 101 and being explained, it may install similarly about FG sensor 101'.
[0099]
The three-dimensional information in an object domain is correctly acquirable by using the above FG sensors 101 as the three-dimensional sensor 10. The anything which can acquire the three-dimensional information not only on the FG sensor 101 mentioned above but an object domain, the three-dimensional sensor 10 may be good, for example, may be a sensor using moire, a sensor using a stereo camera, and a sensor using two or more distance sensors.
[0100]
The sensor using moire can acquire three-dimensional information by, for example, picturizing the moire pattern formed using two slits. By using moire, since the level distribution of the direction of stripes can be measured continuously, highly precise three-dimensional information is acquirable. Moire is a coarse striped pattern produced according to the difference of both spatial frequency, when two regular intensity distribution is piled up. There are moire of the sum produced by the sum of two intensity distribution and moire of the product produced by a product, the photograph which exposed two regular distribution doubly can realize the former, and the latter should just look at the transparency which recorded each regular distribution in piles. A motion of the person 2 is also detectable with high precision by using the information on the phase of a moire pattern.
[0101]
The sensor using a stereo camera is acquiring a stereo image and searching for the corresponding points on this stereo image, for example with two CCD cameras, and can measure the level distribution of an object domain by trigonometry. That is, the three-dimensional information on an object domain is acquirable. Since three-dimensional information is acquired based on a two-dimensional picture, it is highly precise.
[0102]
The sensor using two or more distance sensors can acquire three-dimensional information by measuring the distance of two or more point of measurement of installation and an object domain for two or more distance sensors corresponding to the required point of measurement. By using distance sensors, the influence of disturbance light can acquire three-dimensional information correctly few. Since there is no necessity for image processing, it can have simple composition. The distance sensors to be used may be the types which used trigonometry like an infrared sensor well fundamental anything, and, It may be an ultrasonic sensor and may be a type (what measures the time when light emits and comes back and measures distance) of a time TSUUFU light (Time-to-flight).
[0103]

[Translation done.]

DESCRIPTION OF DRAWINGS

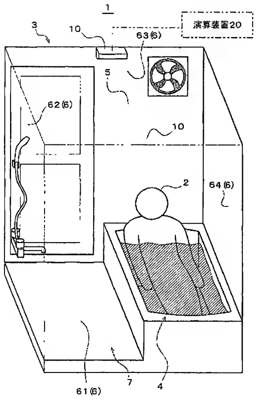
[Brief Description of the Drawings]
[Drawing 1]It is a typical outline view of the indoor monitoring instrument which is a 1st embodiment of this invention.
[Drawing 2]It is a block diagram showing the composition of the indoor monitoring instrument which is a 1st embodiment of this invention.
[Drawing 3]It is a schematic diagram which is used by a 1st embodiment of this invention and in which showing the waveform pattern of breathing.
[Drawing 4]It is a schematic diagram showing the waveform pattern of normal and unusual breathing in the case of drawing 3.
[Drawing 5]It is a figure showing the table of the name of a disease corresponding to the waveform pattern of unusual breathing in the case of drawing 4, or a disease part.
[Drawing 6]It is a typical outline view of the indoor monitoring instrument which is a 2nd embodiment of this invention.
[Drawing 7]It is a notional perspective view of FG sensor which is an embodiment of the invention.
[Drawing 8]It is a mimetic diagram explaining the image of the pattern which carried out image formation to the image formation face in the case of drawing 7.
[Drawing 9]It is a diagram explaining the operation of the height of the subject in the case of drawing 7.
[Drawing 10]It is a typical perspective view explaining the luminescent spot projection device in the case of drawing 7.
[Drawing 11]It is a notional perspective view of FG sensor using the optical cutting method which is an embodiment of the invention.
[Drawing 12]It is a diagram explaining the image of the pattern in the case of drawing 11.
[Drawing 13]It is a typical perspective view explaining the luminescent line projection device in the case of drawing 11.
[Drawing 14]They are the (a) perspective view explaining the grating in the case of drawing 13, and the (b) front view.
[Drawing 15]They are a mimetic diagram of the (a) pattern explaining the pattern projected by the grating of drawing 14, and a front view of the (b) grating.
[Drawing 16]It is a schematic plan view showing the pattern projected by the grating of drawing 14.
[Drawing 17]It is a typical perspective view showing another gestalt of the luminescent line projection device in the case of drawing 11.
[Drawing 18]It is a figure showing another gestalt of the luminescent line projection device in the case of drawing 11, and is an explanation **** mimetic diagram about the combination of the typical perspective view of (a) FG sensor, and the (b) pattern image.
[Drawing 19]They are (a) typical outline view explaining the example in the case of installing FG sensor which is an embodiment of the invention in a bathroom, and the (b) top view.

[Description of Notations]
1 Indoor monitoring instrument
2 Person
3 Bathroom
4 Organ bath
7 Washing place
10 Three-dimensional sensor
20 Arithmetic unit
21 Control section
22 Height change primary detecting element
23 Position detector
24 Motion detection part
25 Risk decision part
31 Storage parts store
38 Alarm equipment
101 FG sensor
101'FG sensor (thing using an optical cutting method)
102 Flat surface
103 Object
105 Light flux generating part
110 Luminescent spot projection device
110a Pattern
110b Luminescent spot
111 Imaging device
114 Control device
115 Image sensor
117 Image processing device
118 Height operation part
120 Grating
121 Optical fiber
122 FG element
201 Indoor monitoring instrument
203 Toilet
204 Toilet bowl
210 Luminescent line projection device
210a Pattern
210b Luminescent line
220 Grating
221 Optical fiber
222 The 1st FG element
223 The 2nd FG element
224 The 3rd FG element

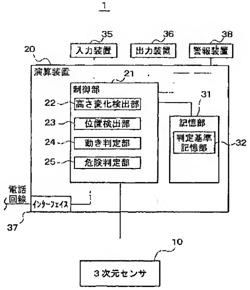
[Translation done.]

DRAWINGS

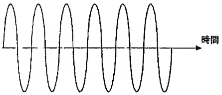
[Drawing 1]



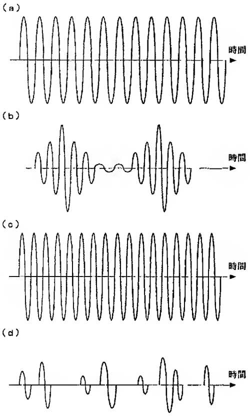
[Drawing 2]



[Drawing 3]



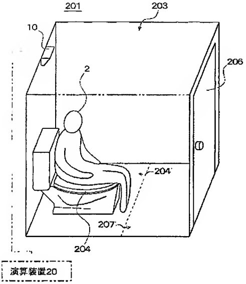
[Drawing 4]



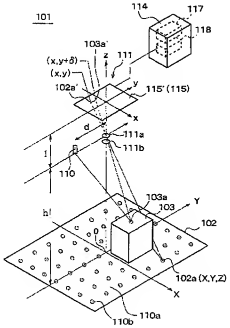
[Drawing 5]

Cheyne-Stokes呼吸	両側大脳皮質下および間脳の障害
中枢性過換気	中脳下部から橋上部の障害
失調性呼吸	橋下部から延髄上部の障害
Kussmaulの大呼吸	糖尿病性昏睡または尿毒症

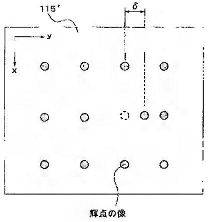
[Drawing 6]



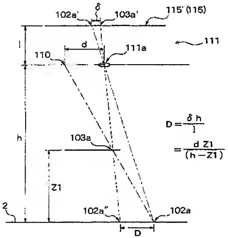
[Drawing 7]



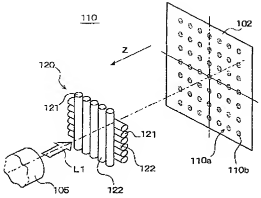
[Drawing 8]



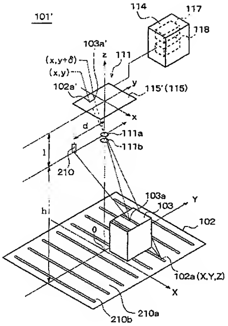
[Drawing 9]



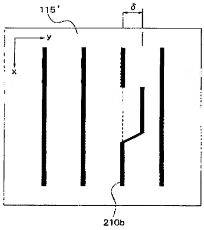
[Drawing 10]



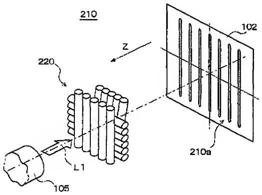
[Drawing 11]



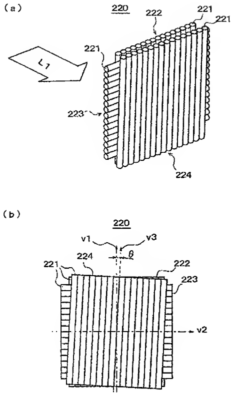
[Drawing 12]



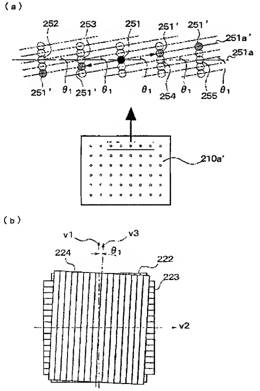
[Drawing 13]



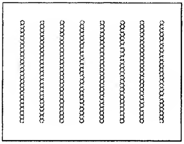
[Drawing 14]


(a)
220
222
221
221
221
L1
223
224
(b)
220
v1
v3
224
θ
221
222
223
v2

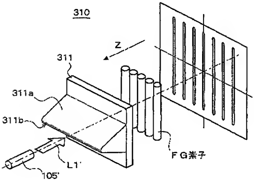
[Drawing 15]


(a)
252
253
251
251'
251'
251a'
251a
251'
θ1
251'
θ1
θ1
254
θ1
255
θ1
210a'
(b)
v1
v3
224
θ1
222
223
v2

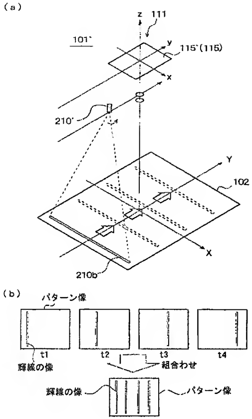
[Drawing 16]



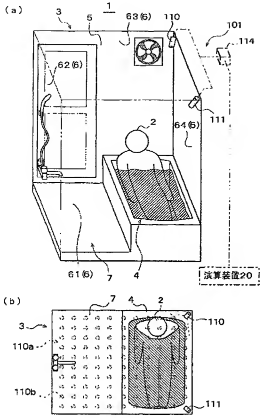
[Drawing 17]



[Drawing 18]


(a)
z
111
101'
y
115'(115)
x
210'
Y
102
X
210b
(b)
パターン像
t1
t2
t3
t4
輝線の像
組合わせ
輝線の像
パターン像

[Drawing 19]



[Translation done.]